Olin Corporation

Wilmington, Massachusetts Facility

Supplemental Phase II Report

Volume VII

June 1997

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Olin Corporation

Wilmington, MA

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Appendix R

APPENDIX R

PHASE II - HUMAN HEALTH RISK ASSESSMENT

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RELEASE TRACKING NO. 3-0471
OLIN CORPORATION
51 EAMES STREET
WILMINGTON, MA

JUNE 1997

PHASE II HUMAN HEALTH RISK ASSESSMENT
RELEASE TRACKING NO. 3-0471

51 EAMES STREET
WILMINGTON, MA

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ACRONYM LIST

AC	Average concentration
ACGIH	American Conference of Governmental Industrial Hygienists
ADD	Average daily dose
ADD_a	Average daily dose, acute
ADD_s	Average daily dose, subchronic
AF	Adherence factor
AP	Averaging period
ATC	Available threshold concentration
ATSDR	Agency for Toxic Substance and Disease registry
AUL	Activity and Use Limitation
bgs	Below ground surface
BW	Body weight
CAEPA	California Environmental Protection Agency
CPC	Contaminant of potential concern
CRA	Conestoga-Rovers & Associates
CRCR	Cumulative receptor cancer risk
CSF	Cancer slope factor
EF	Exposure frequency
ELCR	Estimated lifetime cancer risk
EP	Exposure period
EPC	Exposure point concentration
ERC	Environmental Risk Characterization
GIS	Geographic information system
GRI	Gas Research Institute
HEAST	Health effect assessment summary table
HI	Hazard index
IR	Ingestion rate
kg	Kilograms
LADD	Lifetime average daily dose
LOAEL	Lowest observed adverse effect level
LSP	Licensed Site Professional
MADEP	Massachusetts Department of Environmental Protection
MCL	Maximum Contaminant Level
MCP	Massachusetts Contingency Plan
MF	Modifying factor
µg	Micrograms
mg	Milligrams
MIBK	Methyl isobutyl ketone
MMCL	Massachusetts Maximum Contaminant Level
MRL	Minimum risk level
MWRA	Massachusetts Water Resources Authority
NCEA	National Center for Environmental Assessment

ACRONYM LIST

NCP	National Contingency Plan
NH_3	Ammonia
NH_4^+	Ammonium ion
NOAEL	No observed adverse effect level
NPDES	National Pollutant Discharge Elimination System
NPI	National Polychemical Company
NRC	National Research Council
OHM	Oil or hazardous material
OHMPC	Oil or hazardous materials of potential concern
PAH	Polycyclic aromatic hydrocarbons
PCB	Polychloronated biphenyl
PWS	Public water supply
QA	Quality assurance
QC	Quality control
RA	Risk assessment
RAF	Relative absorption factor
RFC	Reference concentration
RFD	Reference dose
RPF	Relative potency factor
SA	Surface area
SF	Slope factor
SMCL	Secondary Maximum Contaminant Level
SQL	Sample quantitation limit
SVOC	Semi-volatile organic compound
SWMU	Solid Waste Management Unit
TCL/TAL	Target Compound List/Target Analyte List
TEL	Threshold effect level
UCL	Upper concentration limit
UF	Uncertainty factor
UR	Unit risk
URAM	Utility related abatement measures
USEPA	United States Environmental Protection Agency
VOC	Volatile organic compound
VR	Respiration rate

SECTION 1.0

1.0 INTRODUCTION

Olin Corporation (Olin) has conducted a Phase II Human Health Risk Assessment (RA) for the disposal site at the former manufacturing facility location at 51 Eames Street in Wilmington, Massachusetts. This site (RTN: 3-0471) is a Tier IA disposal site under the Massachusetts Contingency Plan (MCP, 310 CMR 40.0000). This RA is prepared in accordance with the MCP (310 CMR 40.0900) and the "Scope of Work, Human Health Risk Assessment, Olin Corporation Wilmington Facility, DEP RTN: 3-0471" dated April 1996 (ABB-ES, 1996a) which was reviewed and conditionally approved by Massachusetts Department of Environmental Protection (MADEP, 1996a; 1996b). This RA is also in substantial compliance with the National Contingency Plan (NCP, 1990).

This RA uses the information compiled during a Phase II Comprehensive Site Assessment (CSA) performed by Conestoga-Rovers & Associates (CRA) for Olin Corporation (CRA,1993), the Supplemental Phase II Comprehensive Site Investigation performed by Smith Technology, Inc. (Smith, 1997), the previously conducted Public Health Risk Assessment (ABB-ES, 1993), and the MADEP's comments on the previous risk assessment (MADEP, 1995c). to assess the public health risks posed by contaminants detected at or having migrated from the Wilmington Facility. It is necessary to have access to the Supplemental Phase II Comprehensive Site Investigation in order to access referenced information within this risk assessment report. The primary goal of this risk assessment is to estimate the potential for adverse health effects to people who may be exposed to chemicals associated with the disposal site, and the potential for impacts to safety and public welfare. Risks to the environment are addressed in a separate document.

1.1 DESCRIPTION OF RISK ANALYSIS AND RISK MANAGEMENT

The risk analysis process can be divided into two components: risk assessment and risk management. The National Research Council (NRC, 1983) defines these as follows: *"Risk assessment is the use of the factual base to define the health effects of exposure to individuals or populations to hazardous materials and situations. Risk management is the process of weighing policy alternatives and selecting the most appropriate action, integrating the results of risk assessment with engineering data and with social economic and political concerns to reach a decision"*. It is important that these two processes remain separate and distinct so that the <u>science</u> of risk assessment is separate from the <u>policy</u> of risk management.

This document primarily addresses the process of risk assessment. Risk management is used only in the context of determining whether the levels of risk calculated in the risk assessment are "significant". The determination of significance is made by comparison of estimated Cumulative Receptor Site Risks to the Cumulative Receptor Site Risk Limits contained in the regulations and by comparison of exposure point concentrations to potentially applicable or suitably analogous standards. If significant risks are identified, then additional response actions will be required to achieve or maintain either a permanent or temporary solution. Appropriate solutions will be developed and described in Phase III - Development of Remedial Response Alternatives and the Final Remediation Action Plan.

The risk assessment process can be divided into five steps: hazard identification, dose-response assessment, exposure assessment, and risk characterization and uncertainty analysis. The **hazard identification** determines what substances are present at a site, whether a substance causes adverse effects, and identifies those effects. The **dose response assessment** describes the relationship between the level of exposure and the likelihood and/or severity of an adverse effect. The **exposure assessment** identifies potential routes of exposure; characterizes the populations exposed; and determines the frequency, duration, and extent of exposure. The last step, **risk characterization**, combines the information from the previous three steps to describe the type (e.g., carcinogenic and non-carcinogenic) and magnitude of risks to the exposed populations. It also identifies the uncertainty in the characterization of risks. Each of these steps is described in later sections of this document.

1.2 PURPOSE

The purpose of this document is to present a human health risk assessment for the Olin Wilmington site. This risk assessment will determine whether exposure to oil and hazardous materials (OHM) present at and migrating from the Wilmington Facility present a "significant" risk to human health, safety, and public welfare, and the results of the risk assessment will be used in determining the need for response actions to meet the requirements of the MCP.

1.3 REGULATORY CONTEXT AND REQUIREMENTS

This RA was prepared consistent with the MCP promulgated under Chapter 21E on October 3, 1988 (310 CMR 40.0000) and amended through February 28, 1997, and is in substantial compliance with the NCP, March 8, 1990, as amended (40 CFR 300); the "Guidance for Disposal Site Risk Characterization" (MADEP, 1995a); and, the "Risk

Assessment Shortform Residential Scenario" (MADEP, 1992). Supplemental guidance was provided by "Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final" (USEPA, 1989) and the "Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors" (USEPA, 1991). This risk assessment is consistent with the Scope of Work, Human Health Risk Assessment, Olin Corporation Wilmington Facility, DEP RTN: 3-0471, April 1996 (ABB-ES, 1996a) that was submitted to the MADEP. The MADEP provided Conditional Approval of that scope of work in a letter on May 16, 1996 (MADEP, 1996a) and Approval of Supplemental Sampling for Risk Assessments (MADEP, 1996b).

1.4 IDENTIFICATION OF CURRENT AND REASONABLY FORESEEABLE USES OF THE SITE AND SURROUNDING ENVIRONMENT

The Wilmington Facility (Facility), located at 51 Eames Street, Wilmington, Massachusetts (Figure 1), is currently owned by Olin Chemical Corporation. The following brief description of the Facility was taken from the Phase II report (CRA, 1993). The 53-acre Facility is a former chemical manufacturing plant. The Facility is located in a heavily industrialized area. Located to the east, west, and north of the Facility are heavy and/or light industries; to the south is the old Woburn Town Dump. The Facility was owned by National Polychemical Company, Inc. (NPI) from its construction in 1953 until 1959. In about 1959, NPI was transferred to American Biltrite Rubber which operated NPI until 1964. Stepan Chemical Company acquired NPI and the plant in 1968 and merged NPI into Stepan in 1971. Olin purchased the plant in 1980 and closed it in September, 1986. Types of chemicals produced included chemical blowing agents, stabilizers, antioxidants, and other specialty chemicals for the rubber and plastics industry.

Figure 2 presents the site features at the Olin Facility. Prior to 1970, liquid waste generated by the Facility was diverted into a series of three acid pits and two unlined East and West Pits or into the "Lake Poly Liquid Waste Disposal Area", which is located along the western boundary of the facility. In 1970, two polyvinyl chloride (PVC)-lined lagoons were constructed over the existing acid pits. Sulfate-bearing liquid waste was mixed with calcium hydroxide slurry to form a sludge that was disposed of in the lagoons. Solids from the lagoons were dredged periodically and were landfilled in the Sulfate Landfill in the southwest corner of the facility. Olin excavated Lagoon I in 1981 and Lagoon II in 1983 and relined them. In 1986, the lagoon system was drained, solids were dredged, liners removed, and the lagoons were covered with fill and abandoned. The dredged materials were disposed of in the Sulfate Landfill and closure activities were completed in approximately 1988.

Another potential source of OHM release is the "Plant B" area in the northeast portion of the Facility. Materials allegedly spilled in the area include di-isobutylene (trimethylpentenes), diphenylamine, bis-2-ethylhexylphthalate, processing oil, dioctylphthalate, diocytldiphenyl-amine, and fuel oil. When Olin purchased the Facility in 1980, the Plant B tank farm sat on grade with no perimeter dike or spill containment system. Olin removed soils for off-site disposal and installed a secondary containment system consisting of a concrete base slab and perimeter curbing. Subsequently, Olin has installed extraction wells to provide hydraulic containment of a non-aqueous phase processing oil and to extract contaminated groundwater. The extracted groundwater is currently treated by hypochlorination to remove ammonia, pH adjustment to precipitate iron, and with granular activated charcoal to remove organics. The treated groundwater is discharged to the On-property West Ditch through a National Pollution Discharge Elimination System (NPDES)-permitted outfall.

The Facility is currently not being used for manufacturing purposes. However, there are a small number of employees working at the Facility. Access to the site property is limited by an eight-foot-high chain-link fence that is locked when the Facility is unattended. A network of ditches intersect the property (Figure 2). The South Ditch begins beyond the fence to the west of the Facility and continues in an eastward direction, joining the West Ditch within the property boundary. A small pond, which was historically connected to the South Ditch, is also located on the Facility. The South Ditch discharges to the East Ditch, which flows south along the eastern border of the Facility. The East Ditch, which receives discharge of groundwater from the property, flows south to Halls Brook, which in turn flows into the Aberjona River.

The closest residential properties to the Facility are located beyond the bordering industrial properties, on Border and Cook Avenues, about one-quarter mile to the southwest of the Facility perimeter. Some residences on Border and Cook Avenues have private wells. These wells are not hydrologically connected to groundwater migrating from the Facility (Smith, 1997). Some of the residences to the west on Main Street formerly had private wells, but these houses are now connected to the Wilmington Public Water Supply (PWS). All private drinking water wells have been abandoned, and Limitations with Respect to Groundwater are currently in place or are expected to be in place in the near future, as temporary risk reduction measures to prevent the construction of new wells at those properties. The abandoned wells have been previously tested and no chemicals have been detected at levels that exceed USEPA Maximum Contaminant Levels (MCLs). A small number of homes are also located to the northeast of the Facility at the intersection of Eames and Woburn Streets. These homes are also separated from the Facility by large neighboring industrial facilities. No private wells were identified to the east of the site and in the northern portion of Woburn (CRA, 1993).

Altron Corporation, located approximately 500 feet west of the Facility, currently has two wells in operation that are pumped at approximately 180,000 gallons per day (Personal Communication, 1997). The groundwater is used in Altron's manufacturing process. The water is then discharged to the Massachusetts Water Resources Authority (MWRA) sewer system.

No specific populations of sensitive receptors were identified within a one-half-mile radius of the Facility. There are no schools, hospitals, or nursing homes in this area. Five public water supply wells for the Town of Wilmington are located approximately one-half mile to the northwest. Groundwater in the northeast portion of the Facility (Plant B area) is currently intercepted by a pump-and-treat containment system. If the system were not in operation, groundwater would discharge to the East Ditch. For this assessment, the containment system is considered an ongoing risk reduction measure that will continue to operate until there is no longer a threat of release of OHM or until other permanent remedial measures are undertaken to eliminate the threat of release. Per 310 CMR 40.0923(5), the conclusions of this assessment relative to the threat of release from the subsurface in the area of Plant B are valid as long as this temporary risk reduction measure is maintained and/or future remedial actions eliminate the threat of release. In the future, the Facility may again be put to industrial use. An Activity Use and Limitation (AUL) will ensure that this future use scenario of the Facility property will be maintained and that residential use of the property will not occur. The industrialized nature of the surrounding area is expected to remain essentially the same.

1.5 CONCEPTUAL SITE MODEL

Based on previous investigations of releases of OHM and the fate and transport of OHM at the site and in the surrounding environment, a conceptual site model has been developed. Historically, prior to Olin's purchase of the property, processing waste materials including dense, acidic chromium-containing liquid waste were disposed on the land surface in the former acid pits and Lake Poly Liquid Waste Disposal area.

The conceptual site model identifies potential source areas from which OHM may have been released and also identifies the migration pathways through which OHM may have been transported and/or translocated to other environmental media. As identified in Section 1.3 of the Supplemental Phase II Report, there are six major sources or reservoirs of released OHM: the Lake Poly Liquid Waste Disposal Area and the other unlined pits; the dense layer of inorganics at the base of the aquifer; the surface water drainage ditch system; the Plant B Production Area and Tank Farm; the Drum Disposal Areas; and the Sulfate Landfill. These sources/reservoirs (except the dense layer) are shown in Figure 2. Each of these areas is described in detail in Section 1.3 of the Supplemental Phase II Report.

The liquid waste disposed in the Lake Poly Liquid Waste Disposal Area and the unlined pits contained chromium, sulfuric acid, sodium chloride, sodium sulfate, and other inorganic and organic constituents. These dense, acidic wastes penetrated the soil surface and migrated vertically through the subsurface soil and through the groundwater until they contacted the bedrock surface. The dense, acidic chromium-containing liquid flowed along the bedrock surface predominantly to the west, and to a lesser extent to the east and south. It also appears the dense, acidic chromium-containing waste was released from the Lake Poly Liquid Waste Disposal Area to the On-property West Ditch.

The environmental investigations conducted to date indicate that soils in the Lake Poly Liquid Waste Disposal Area contain substantial concentrations of chromium, N-nitrosodiphenylamine, trimethylpentenes, phthalates, mercury, and ammonia. Groundwater in the area immediately to the south and southwest of the Lake Poly Liquid Waste Disposal Area (and west of the acid pits) contains elevated concentrations of chromium, N-nitrosodiphenylamine, trimethylpentenes, and ammonia.

Drum Area A subsurface analysis indicates the presence of volatile organic compounds (VOCs), N-nitrosodiphenylamine, phenol, phthalates, calcium, sodium, and sulfate at elevated concentrations and groundwater analysis suggests the presence of Kempore™ in the subsurface.

Drum Area B subsurface analysis indicates the presence of VOCs, N-nitrosodiphenylamine, phthalates, sodium, and sulfates at elevated concentrations.

In the Plant B area, phthalates, oils, and ammonia have been detected in subsurface soils and groundwater, indicating release of those materials may have occurred at the Plant B Area.

The sediments in the drainage ditch system contain substantial concentrations of OHM found elsewhere on the site, including, but not limited to, chromium, N-nitrosodiphenylamine, phthalates, trimethylpentenes, polycyclic aromatic hydrocarbons (PAHs), 4-bromophenyl-phenylether and 4-chlorophenyl-phenylether.

Three other small areas of stained soils, SWMU-27, SWMU-30, and SWMU-33, have surface soils that contain elevated levels of chromium, phthalates, and n-nitrosodiphenylamine (SWMU-27 only). These areas are shown in Figure 3.

Shallow groundwater was also affected by the waste disposal practices. The shallow groundwater in the area of the former acid pits and the Lake Poly Liquid Waste Disposal Area has been impacted by the acidic chromium-containing liquid waste and VOCs, including trimethylpentenes. The shallow groundwater has historically discharged to the Off-property West Ditch and the South Ditch, with associated migration of ammonia, chromium, calcium, sulfate, and other analytes to the ditches. The Off-property West ditch flows onto the property into the South Ditch, which flows eastward across the site to the Off-property East Ditch; the East Ditch flows southward. The shallow groundwater containing low levels of chromium and VOCs has also migrated a short distance east of the property (as far as the East Ditch).

Historically, the surface water within the Off-property West Ditch, the On-property South Ditch, and the East Ditch downstream of the Facility contained elevated levels of chromium and white chromium flocculent material. Since the installation of the weir in the South Ditch in 1994, surface water samples collected in the West Ditch and South Ditch no longer exhibit elevated chromium concentrations, but chromium flocculent material (red in color) is still observed in the On-property and Off-property ditches (Smith, 1997).

The ditch sediments contain elevated levels of ammonia, calcium, chromium, N-nitrosodiphenylamine, phthalates, sulfates, and trimethylpentenes and other organic compounds.

1.6 SELECTION OF METHOD FOR CONDUCTING THIS RISK ASSESSMENT

Three risk assessment methods are described in the MCP. Method 1 risk assessments involve comparison of soil and groundwater concentrations to published, generic risk-based cleanup standards for industrial chemicals. Method 2 risk assessments evaluate risks using site-specific risk-based cleanup standards for individual chemicals, possibly in conjunction with Method 1 standards for other chemicals. Both Methods 1 and 2 are chemical-specific assessment/management approaches. Method 3 risk assessments evaluate the cumulative cancer and non-cancer risks associated with exposures at a site and also consider applicable or suitably analogous public health standards. The Method 3 approach is a cumulative risk approach rather than a chemical-specific approach.

Because applicable or suitably analogous standards do not exist for all OHM in all exposure media at all exposure points (eliminating Method 1 as the sole method), and because exposure to potential human receptors involves media other than soil and groundwater (surface water and sediment), thereby eliminating Methods 1 and 2 (310 CMR 40.0971 (2) and 40.0981), Method 3 has been selected as the appropriate method to evaluate human health risk at this multi-media site.

SECTION 2.0

2.0 HAZARD IDENTIFICATION

The hazard identification process identifies the OHM present at a site, summarizes the analytical data that have been collected, and describes the potential health effects that may be associated with exposure to these OHM. In addition, the rationale for exclusion of analytes as OHM of potential concern (OHMPC) is also described.

The analytical data were managed in the following manner. For each medium, all analytical samples were identified, samples appropriate for use in the risk assessment were selected (i.e., QA/QC samples were eliminated, outdated analytical data were eliminated, background samples were eliminated), OHMPC were identified, a hot spot analysis was conducted, exposure points were identified, exposure point concentrations (EPCs) were calculated (sample results were grouped spatially and temporally to best represent exposure), and receptor-specific "overall site EPCs" were calculated.

Samples representative of actual and potential exposures were selected for use in the risk assessment. When there were multiple rounds of sampling and analysis, the following general guidelines were followed. For groundwater, the most recent analytical results at each sampling location were selected. This would represent the most recent conditions in a medium that may change considerably over time due to migration, dilution, and diffusion. For surface water, the most recent analytical results were selected to represent the most recent conditions in a medium that may change considerably over time due to rainfall events, advection, diffusion, and groundwater discharge to the surface water. Historical surface water data were also evaluated. For those media that are stationary (e.g., soil and sediment), all of the available data were selected to represent the exposure potential for persistent OHM (inorganics and metals, semi-volatile organic compounds [SVOCs], pesticides).

The CSA (CRA, 1993) and the Supplemental Phase II Investigation (Smith, 1997) summarize all of the sampling and chemical analyses that have been conducted at the site. In addition, the Supplemental Phase II Investigation presents the distribution and concentrations of selected OHM that have been released.

2.1 IDENTIFICATION OF THE EXTENT OF RELEASE OF OHM

Sampled media include surface soil, subsurface soil, surface water, sediment and floc material collected within the fenced area of the Facility, surface water and sediment collected from beyond the fenced perimeter of the Facility (East Ditch, Off-property West Ditch), and groundwater (both On-property and Off-property). On-property drummed waste was also sampled in the Phase II CSA. All data collected in the Phase II CSA, as well as a complete description of the sampling programs, are presented in the Phase II report (CRA, 1993), and all data collected in the Supplemental Phase II CSA are presented in the Phase II Supplemental Report (Smith, 1997).

The limits of the disposal site (as defined by the MCP), based on the above data, are illustrated in the Phase II Supplemental Report.

2.2 PRESENTATION OF ANALYTICAL DATA

For the samples selected for RA, Tables 1 through 7 present data summaries for the OHM (VOCs, SVOCs, *pesticides/Polychlorinated biphenyl (PCBs), inorganics, Opex™, and* Kempore™) detected in the sampled media (surface soil, subsurface soil, Zone II groundwater, non-Zone II groundwater, surface water [recent and historical], and sediment, respectively). The frequency of detection, range of detected concentrations, arithmetic mean of all samples with one-half the Sample Quantitation Limit (SQL) assigned to non-detects, and background concentration (where available) are presented for each chemical. The following sections describe the data collection and data summarization activities. To simplify the discussion in this text of these data (more than 2,000 samples), the sample <u>locations</u> are identified even though multiple samples may have been collected at a given surface water, sediment, or groundwater location. All samples that have been used in this RA are identified in Attachment 1.

2.2.1 Surface Soil

In 1991, CRA collected 14 surface soil samples (including one duplicate). Ten composite samples (plus one duplicate) were collected from an approximately 200-foot grid as shown on Figure 3. Each of these samples (designated Area 01 through Area 10) comprises four grab samples collected within the grid area. Three additional composite samples (each consisting of three grab samples) were collected and designated SWMU-27, SWMU-30, and SWMU-33. All 1991 samples were collected from zero to six inches below ground surface (bgs).

In 1993, a composite surface soil sample (two grab samples), was collected in the area of Plant B and designated SWMU-25.

In 1996, Smith collected 54 additional surface soil samples including two field duplicates (shown on Figure 3) to characterize conditions at additional locations on the Facility. Ten surface soil samples (including one duplicate) (CPDA-1 through CPDA-9) were collected in the two central pond drainage areas within grid area 8. Four grab samples (G1-DRMB through G4-DRMB [analyzed only for volatiles]) and one composite sample (DRMB) were collected in Drum Area B. Four grab samples (GA1-DRMA through GA4-DRMA [analyzed only for volatiles]) and one composite sample (DRUMA [COMPA]) were collected from area A of Drum Area A. Area A within Drum Area A is in the vicinity of Test Pit 8. Four grab samples (GB-1 DRMA through GB4-DRMA [analyzed only for volatiles]) and one composite sample (DRMA [COMPB]) were collected in area B of Drum Area A. Area B of Drum Area A is in the vicinity of Test Pits 6 and 7. Three samples and a duplicate (Lake Poly-1 through Lake Poly-3) were collected in the area of the Lake Poly Liquid Waste Disposal Area. Nine surface soil samples were collected in the central wetland area that spans grid areas 8 and 9 (A8CW-1 through A8CW-4 and A9CW-1 through A9CW-4 and A9CW-(COMP). In addition, six grab samples (analyzed only for volatiles) and one composite sample (Area 1-1 through Area 1-6 and Area 1 COMP) were collected in grid area 1. Also in 1996, four grab samples (Area 8-1 through Area 8-4) were collected around the Central Pond in grid area 8.

In 1997, ABB-ES collected seven surface soil samples as shown on Figure 3 from the property. One sample (BS 021 REF) was collected at an Off-property reference location and is therefore not used here to characterize site exposure. Two samples (BS013WDX and BS014WDX) were collected in the area of SWMU-27 and the On-property West Ditch. One sample (BS015SDX) was collected within SWMU-30 along the South Ditch and another sample (BS016SMD) was collected near SWMU-33 in the south meadow area. Two additional surface soil samples (BS017PND and BS018PND) were collected in the area of the Central Pond.

All surface soil samples collected to delineate the releases of OHM are used in the human health RA. All surface soil samples that have been used in the human health RA are listed in Attachment 1.

The background soil sampling locations and analyte concentrations are presented in Section 4.1 of the Supplemental Phase II Report and are also presented in Attachment 2. The seven soil background sampling locations are Off-property, as shown in Figure 4. The median and maximum concentrations for site-specific background analytes and the MADEP-published soil background concentrations are shown in Table 1 and in Attachment 2. Site-specific soil background concentrations were characterized for ammonia, calcium, potassium, sulfate, nitrate, and PAH compounds. MADEP-published background soil concentrations (MADEP, 1995a) are used here for the remaining metals and inorganics.

A surface soil sample was collected from SWMU 27 (an area of high chromium concentration) to determine the proportion of hexavalent chromium versus total chromium. A concentration of 280J mg/kg of total chromium and 17J for hexavalent chromium was reported in this sample, indicating that hexavalent chromium is less than 10 percent of total chromium concentrations. As discussed in 4.3.3.3 of the Supplemental Phase II Report, the reported presence of hexavalent chromium in soil and sediment is presumed to be suspect but assumed to be present at these concentrations (10% hexavalent; 90% trivalent) for the risk assessment. In other media, evaluations were based on analytical results for total, trivalent and hexavalent chromium. Further discussion of this matter is presented in Section 4.3.3 of the Supplemental Phase II Report (Smith, 1997).

Surface soil samples were analyzed for the full Target Compound List (TCL)/Target Analyte List (TAL) parameters plus 2,4,4-trimethylpentene, ammonia, chloride and sulfate. Table 1 presents a summary of surface soil data.

2.2.2 Subsurface Soil

In 1991 and 1992, 43 borehole (subsurface soil) samples (shown in Figure 5) were collected to characterize possible releases of OHM (BH01 through BH40). Two samples were collected at 4-6 feet bgs and 10-12 feet bgs at BH11, two samples collected at BH28 at 4-6 feet bgs, and two samples collected at BH32. At each of the other sampling locations, a single sample was collected from one of the following depths: 3-5 feet bgs, 4-6 feet bgs, 5-7 feet bgs, 6-8 feet bgs, 7-9 feet bgs, and 8-10 feet bgs. All subsurface soil samples were analyzed for inorganics, metals, pesticides and PCBs, volatiles (including trimethylpentenes), and semivolatiles.

In addition, in 1991, eight test pit samples (shown on Figure 5) were collected. Three of those samples are for subsurface soil (TP-1-SN1, TP-19-SN6, TP-21-SN8) and the remainder of the test pit samples are considered waste samples. These samples were collected in Drum Area A (TP-21-SN7) and Drum Area B (TP-6-SN2 through TP-6-SN4). In this assessment, these waste samples are treated as subsurface soil for future exposure scenarios. All of these samples were analyzed for inorganics, metals, pesticides and PCBs, volatiles (including trimethylpentenes), and semivolatiles.

In 1992, four subsurface waste samples (shown on Figure 5) were collected from formerly excavated materials in Drum Area A (OW-249A) and in Drum Area B (OW-249B through OW-249D). These samples were analyzed for miscellaneous parameters, metals, pesticides and PCBs, volatiles (including trimethylpentenes) and semi-volatiles to characterize the waste for disposal. In 1995, four subsurface soil samples (shown on Figure 5) were collected in the area of the Lake Poly Liquid Waste Disposal Area [LPB-1 (4-6 feet bgs), LPB-1 (6-8 feet bgs), LPB-2 (7-8 feet bgs), and LPB-2 (8-9 feet bgs)]. These samples were analyzed for miscellaneous parameters, inorganics, metals, volatiles (including trimethylpentenes), and semivolatiles.

All subsurface soil samples collected to delineate the releases of OHM are used in the human health RA. The waste samples collected from the subsurface are treated here as subsurface soil for the purposes of the exposure assessment. Table 2 presents a summary of subsurface soil data. All subsurface soil samples that have been used in the human health risk assessment are listed in Attachment 1.

The background soil sampling locations and soil background concentrations are presented in Section 4.1 of the Supplemental Phase II Report and in Attachment 2. The soil background data set has been used to select OHMPC for both surface and subsurface soils. The seven soil background sampling locations are Off-property as shown in Figure 4. The median and maximum concentrations for site-specific background analytes and the MADEP-published soil background concentrations are shown in Table 2. Site-specific soil background concentrations were characterized for ammonia, calcium, potassium, sodium, sulfate, and PAH compounds. MADEP-published background soil concentrations (MADEP, 1995a) are used here for the remaining metals and inorganics.

2.2.3 Groundwater

More than 2,000 groundwater samples have been collected. Samples were collected from monitoring wells, private wells, and Town of Wilmington Water Supply Wells. The CSA report (CRA, 1993) and the Phase II Supplemental Report (Smith, 1997) identify the numerous groundwater sampling and analytical programs. Groundwater data for sample locations within the disposal site boundary as shown on Figure 6 were grouped based on groundwater categories and potential future use of the groundwater. Groundwater that is within the zone of contribution of the Wilmington PWS (referred to as Zone II groundwater) was evaluated separately. All other groundwater data were grouped together as non-Zone II groundwater. The boundaries of these two areas are shown in Figure 3-7 of the Phase II Supplemental Report (Smith, 1997) and Figure 14 of this RA.

Previously, private bedrock wells on Cook Avenue and Border Avenue had been considered in the risk characterization for the Facility. However, based on the

Supplemental Phase II Investigation findings, it has been concluded that there is not a hydrogeologic connection between these wells and groundwater impacted by site contaminants. Therefore, these wells are not considered part of the disposal site. In addition, a 500-foot radius around these wells (which would define GW-1 groundwater) does not intersect the disposal site.

Figure 6 identifies the location of monitoring wells and Town wells that were sampled. Table 3 presents a summary of groundwater sampling data that are not within the zone of contribution (Zone II) of the PWS. Samples that have been used in the human health RA are listed in Attachment 1. Table 4 presents a summary of groundwater data associated with sampling locations within Zone II of the PWS. Deep groundwater samples that have been used in the human health RA are presented in Attachment 1. All groundwater sampling locations are shown on Figure 6.

The background groundwater sampling locations and groundwater background concentrations are presented in Section 4.1 of the Supplemental Phase II Report and in Attachment 2. As discussed in Attachment 2, the background data were collected from monitoring wells, private wells, and Town wells that do not appear to have been impacted by this site or any other disposal site. It should be noted that although two of the private well samples (located at properties M-25/L-08 and M-25/L-07) that are included in the background data set appear to be located within the disposal site, they are screened at shallow depths that are above the plume and the water quality data in those wells indicate they are not impacted by the disposal site. The groundwater background data set has been used to select OHMPC for both shallow and deep groundwater. The groundwater background sampling locations are Off-property as shown in Figure 7. The median and maximum concentrations for site-specific background analytes are presented in Table 3 and Table 4.

<u>Monitoring Well Samples</u>. The results of analysis of most recent groundwater samples at each location were used in this assessment. These samples were analyzed for the site-specific parameter list of compounds, which includes TCL/TAL parameters (minus the pesticide and PCBs fraction) plus 2,4,4- trimethylpentenes, ammonia, chloride, and sulfate.

<u>Town Well Samples</u>. The Butters Row #1, Butters Row #2, Chestnut Street #1, Chestnut Street #1 A/2, and Town Park water supply wells have been sampled quarterly in recent years and analyzed for ammonia, chloride, sodium, and sulfate. Chestnut Street #1 and Butters Row #1 (pre- and post-treatment water) were also sampled in the spring of 1997 and analyzed for VOCs, metals, and inorganics. The spring 1997 samples and the last year of quarterly

samples, in addition to the post-treatment water from Butters Row #1, have been selected to represent current conditions at these town wells. There is no indication that Chestnut Street well 1A/2 or the Town Park well are within the boundaries of the disposal site.

2.2.4 Surface Water

Numerous surface water samples were collected prior to 1992, but these data are outdated and not suitable for the RA. In 1992, two rounds of sampling (a total of 45 samples including three duplicates) were conducted at locations SW-01 through SW-18 (duplicates were collected at SW-06 (second round) and SW-17 (first and second rounds) [two samples at each location] and SW-19 through SW-24 [one sample at each location]).

In early 1993, one round (a total of six samples) of sampling was conducted at locations SW-25 through SW-30. Surface water samples collected in 1992 and 1993 were analyzed for miscellaneous parameters, inorganics, metals, pesticides and PCBs, volatiles (including trimethylpentenes), and semivolatiles.

Throughout 1995, 25 filtered and 24 unfiltered surface water samples were collected at locations designated by Geomega as SW-11, SW-12, SW-14, SW-15, SW-16, SW-17, and SW-18. The Geomega sampling locations and identifiers do not correspond to the previously sampled locations with those identifiers. In this RA, any Geomega sample collected at a previously sampled surface water location was assigned the location identifier of the historical location. Any Geomega samples not collected at a historical sampling location have been assigned a location identifier beginning with "G" and using the Geomega numerical surface water sampling location identifier as shown below.

GEOMEGA IDENTIFIER	HISTORICAL LOCATION	RISK ASSESSMENT IDENTIFIER	SUPPLEMENTAL PHASE II IDENTIFIER
SW-11	SW-15	SW-15	SW-11-95
SW-12		GSW-12	SW-12-95
SW-14	SW-18	SW-18	SW-14-95
SW-15		GSW-15	SW-15-95
SW-16	SW-9	SW-9	SW-16-95
SW-17	SW-11	SW-11	SW-17-95
SW-18		GSW-18	SW-18-95

Each of the 1995 surface samples was analyzed for miscellaneous parameters, inorganics, and metals (total for unfiltered samples, dissolved for filtered samples).

In 1996, ten filtered samples (SO. DITCH #1 through SO. DITCH #4 and SO. DITCH POND) were collected. Five of the filtered samples were analyzed for miscellaneous parameters, dissolved metals, and inorganics. The other five samples were analyzed for hexavalent chromium.

Only data from unfiltered surface water samples are evaluated in the human health RA. All surface water sampling locations are shown in Figure 8. Historical and recent surface water analytical data are summarized in Table 5 and Table 6, respectively.

Fifteen surface water background samples (including one duplicate) were collected in April 1996. A full description of all background sampling, analysis, and interpretation for surface water is presented in Attachment 2. The background surface water sampling locations are identical to the sediment background locations. These locations and surface water background concentrations are presented in Section 4.1 of the Supplemental Phase II Report and Attachment 2. The 15 surface water background sampling locations are Off-property as shown in Figure 4. The median and maximum concentrations for site-specific surface water background analytes are presented in Table 5 and Table 6. All 15 surface water background samples were analyzed for pesticides. Five samples were analyzed for miscellaneous parameters, metals, pesticides, volatiles (including trimethylpentenes), and semivolatiles.

2.2.5 Sediment

In 1992, two rounds of sampling (a total of 45 samples including two duplicates) were conducted at locations SW-01 through SW-06 and SW-08 through SW-22 (with a duplicate at SW-06, SW-17). Location SW-07 was sampled in only one round during that period. In late 1992 and early 1993, one sampling round (a total of seven samples) was conducted at locations SW-23 through SW-30 (excluding SW-28). Two of these samples were collected upstream of the site, at SW-29 and SW-30; analytical results from SW-30 were identified as local conditions because that sample contained no contaminants indicative of a release at the site. Sample SW-29 has been included in the site data set because site-related compounds were detected in that sample.

Sediment samples collected in 1992 and 1993 were analyzed for miscellaneous parameters, inorganics, metals, pesticides and PCBs, volatiles (including trimethylpentenes), and semi-volatiles.

In 1995, one sediment sample (POND) was collected from the Central Pond. This sample was analyzed for miscellaneous parameters, inorganics, metals, pesticides and PCBs, volatiles (including trimethylpentenes), and semivolatiles. A sample was also collected with a designation SED-17, 11, which is a composite from two locations. This latter sample has not been used in the RA because it does not provide meaningful information concerning sediment quality at either of the two locations from which the sample was composited.

In 1997, eight sediment samples were collected by ABB-ES to provide analytical data in support of tissue analysis and toxicity testing studies that are part of the Environmental Risk Characterization (ERC). These samples are designated BS005WDX, BS006WDX, BS007WDO (from the West Ditch); BS008SD (South Ditch); BS009PND and BS010PND (from Central Pond); BS011WMD (Wet Meadow); and BS012REF (an Off-property reference location). Sample BS012REF has not been used here to characterize release of OHM from the site. All 1997 sediment samples were analyzed for inorganics, metals, pesticides, and semivolatiles.

All sediment sampling locations are shown on Figure 9. Sediment analytical data are summarized in Table 7.

Fifteen sediment background samples (including one duplicate) were collected in April 1996. A full description of all background sampling analysis and interpretation for sediment is presented in Attachment 2. The background sediment sampling locations and sediment background concentrations are presented in Section 4.1 of the Supplemental Phase II Report. The 15 sediment background sampling locations are Off-property as shown in Figure 4. The median and maximum concentrations for site-specific sediment background analytes are shown in Table 7. All 15 samples were analyzed for metals, pesticides, hexavalent chromium, volatiles (including trimethylpentenes), semivolatiles, and total organic carbon.

2.3 SELECTION OF OIL OR HAZARDOUS MATERIALS OF POTENTIAL CONCERN (OHMPC)

Selection of OHMPC was conducted in a manner consistent with the MCP. In general, all detected analytes have been retained as OHMPCs unless they meet certain criteria that allow them to be excluded from the RA. MADEP guidance (1995a) lists several reasons why an individual chemical may be dropped from the quantitative risk characterization, including:

- The chemicals are laboratory contaminants.

- Reported levels are consistent with "background" and there is no evidence that their presence is related to the disposal at the location.
- Chemicals are present at low frequency of detection and low concentration and no history of past and no evidence of current use of the OHM at the site

The following text presents specific criteria that were used to exclude contaminants from the list of OHMPC consistent with MADEP guidance.

Laboratory Contaminants. Using criteria identified by USEPA (1989), CRA identified contaminants whose detection is attributable to laboratory contamination as part of the CSA: this is described in Section 6.1 of the Phase II Field Investigation Report (CRA, 1993). Those analytical results associated with blank contamination less than five times the blank concentration (for common lab contaminants), or ten times the blank concentration (for other contaminants) were considered to be non-detects. Any analyte that was not "detected" in any sample for that medium (after the blank comparison process was completed) was not retained as an OHMPC.

Background Concentrations. For media and analytes for which site-specific background analyses were available, an analyte was considered to be "consistent with background" if a statistical analysis concluded that site concentrations are less than the site-specific background concentration. In this case, a simple comparison of maximum concentrations and median concentrations between site data and background data was conducted. As recommended in the Guidance for Disposal Site Risk Characterization (MADEP, 1995a), median and maximum values are selected as summary statistics representing measures of central tendency and spread and are used to compare the site-specific data to the background data. The following criteria, specified in Section 2.3.3.2 of the Guidance for Disposal Site Risk Characterization (MADEP, 1995a), were used to evaluate whether the site-specific data are consistent with the background data:

- If both the median and the maximum values for the site data are greater than the corresponding values from the background data, then the site data are not considered to be consistent with background.

- If both the median and maximum values for the site data are equal to or less than the background data, then the site data are considered to be consistent with background.

- If the median of the site data is less than or equal to the median of the background data, and the maximum of the site data is no more than 50% greater than the maximum for the background data, then the site data are considered to be consistent with background.

- If the maximum of the site data is less than or equal to the maximum of the background data, and the median of the site data is no more than 50% greater than the median for the background data, then the site data are considered to be consistent with background.

This type of comparison was used for surface water, sediment, groundwater, and for ammonia, calcium, potassium, sodium, sulfate, and PAHs in soil. However, adequate site-specific background characterization was not available for a number of analytes in soil.

For soil analytes without site-specific background characterization, an analyte was considered to be "consistent with background" if the maximum site concentration is less than the background concentrations specified in the MADEP risk assessment guidance (MADEP, 1995a).

A complete description of the sampling, analysis, and interpretation of those results in characterizing background concentrations for the Facility is presented in Attachment 2.

Low Frequency of Detection and Low Concentration. Each analyte detected less than three times for a particular medium (with a minimum of ten samples) was not retained as an OHMPC if the maximum reported concentration of that analyte was less than twice the sample quantitation limit reported by the laboratory (this is the method detection limit adjusted for dilution and/or moisture content considerations). If one or both of these criteria were not met, "low frequency of detection and low concentration" was not considered applicable.

Virtually all detected analytes have been retained as OHMPC. Although a more rigorous statistical analysis (such as a comparison of population means) may have concluded that a few more inorganics are consistent with background, such an effort would be unlikely to have any substantial impact on the results and conclusions of the RA because the predominant risk drivers at the site are present at clearly elevated concentrations that are obviously not consistent with background.

In this RA, OHMPCs were selected as follows: all data considered most representative of current and future potential exposures were selected for use in the RA (clearly identified laboratory artifacts would be eliminated at this point); the data were sorted by medium; the data for each medium was summarized separately; an OHMPC selection table was prepared for each medium (the OHMPC selection table contains frequency of detection, range of SQLs, range of detected concentrations, median concentration, and background screening concentrations); and the "background" and "low frequency and low concentration" criteria discussed above were applied to the data in each OHMPC selection table to select OHMPC for each medium.

2.3.1 Surface and Subsurface Soil

The summary of site surface soil data is presented and surface soil OHMPCs are selected in Table 1. The following analytes were not retained as OHMPCs in surface soils:

> 1,1 - Dichloroethane; 1,2 - Dichloroethane; 2,4,4 - Trimethyl - 2 - pentene; 4 - Methyl - 2 - Pentanone (MIBK); Benzene; Styrene; Trichloroethene; Xylenes (total); 1,2,4 - Trichlorobenzene; 2 - methylphenol (o-Cresol); 4 - Methylphenol (p-Cresol); Dibenzo(a,h)Anthracene; Dimethylphthalate; Beta - BHC; Delta - BHC; Endrin Aldehyde; Copper; Magnesium; and Potassium.

The summary of site subsurface soil data is presented and subsurface soil OHMPCs are selected in Table 2. The following analytes were not retained as OHMPCs:

> Choromethane (Methyl Chloride); Aluminum; Lead; Magnesium; and Zinc.

2.3.2 Groundwater

The summary of site groundwater data is presented and groundwater OHMPCs are selected in Table 3 and Table 4.

For groundwater not in the Zone II of the Wilmington PWS, only VOCs (and ammonia) were selected as OHMPCs. For this groundwater, the reasonably foreseeable exposures are related to potential vapor migration into buildings. Volatiles not retained as OHMPCs in the non-Zone II groundwater include: 1,1,2 - Trichloroethane; 1,2 - Dichloropropane; and chlorobenzene.

For groundwater within the Zone II of the Wilmington PWS, the following analytes were not retained as OHMPCs: 1,1,1 - Trichloroethane; 1,1 - Dichloroethane; Chloromethane; 1,3 - Dichlorobenzene; 2 - Methylnapthalene; ; 1,2,4 - Trichlorobenzene; 2,4 - Dimethylphenol; 2,6 - Dinitrotoluene; 2 - Chlorophenol; Di-n-octylphthalate; Dimethylphthalate; Pyrene; and, Heptachlor Epoxide.

2.3.3 Surface Water

The summary of site surface water data is presented and surface water OHMPCs are selected in Table 5 and Table 6.

The following analytes were not retained as OHMPCs in surface water using historical data:

> 1,1 - Dichloroethane; 2 - Butanone; Dibromochloromethane; 1,2,4 - Trichlorobenzene; 1,4 - Dichlorobenzene; 2 - Methylphenol (o- Cresol); 4 - Nitrophenol; Benzo (a) Pyrene; Di - n - butylphthalate; and Heptachlor Epoxide.

The following analytes were not retained as OHMPCs in surface water using recent data:

> Arsenic; Trivalent Chromium; and Zinc.

It should be noted that in the East Ditch near the site and downstream, a number of VOCs were quantified at concentrations less than upstream background concentrations: 1,1-dichloroethane, chloromethane, ethylbenzene, toluene, and xylene. These analytes were considered OHMPCs, but their concentrations may not be a result of site activities.

2.3.4 Sediment

The summary of site sediment data is presented and sediment OHMPCs are selected in Table 7. The following analytes were not retained as OHMPCs in sediment:

> 1,1 - Dichloroethene; 1,2 - Dichloroethane; Bromodichloromethane; bis (Chloromethyl) ether; 4 - Methylphenol (p-Cresol); Acenaphthene; Acenaphthylene; Benzyl Alcohol; Diethylphthalate; Nitrobenzene; Dieldrin; Hexavalent Chromium; Magnesium; and Thalluim.

2.4 DESCRIPTIVE TOXICITY SUMMARIES FOR OHM OF POTENTIAL CONCERN

Brief toxicity profiles for OHMPCs are presented in Attachment 4.

SECTION 3.0

3.0 DOSE-RESPONSE ASSESSMENT

The purpose of the dose-response assessment is to characterize the relationship between the dose of contaminant administered or received and the incidence of adverse health effects in the exposed population. From this quantitative dose-response relationship, toxicity values (e.g., slope factors, reference dose values or reference concentrations) are derived that can be used to estimate the likelihood of adverse effects as a function of human exposure to an agent. These toxicity values are used in the risk characterization process to estimate the potential for adverse effects occurring in humans at different exposure levels.

The dose-response relationship(s) for each chemical that has been selected as a (OHMPC) is presented in this section. The dose-response information may be divided into two major categories:

- Toxicity information associated with threshold (non-carcinogenic) health effects.
- Toxicity information concerning carcinogenicity, either from human epidemiologic data, or from laboratory studies.

All the chemicals selected as a OHMPC are evaluated for potential *non-carcinogenic* health effects. In addition, any substance considered to be a *known*, *probable*, or *possible* human carcinogen is also evaluated for its potential carcinogenic effects. The classification of a chemical as a carcinogen does not preclude an evaluation of that same chemical for potential non-carcinogenic health risks, as all potentially carcinogenic chemicals may also exert non-carcinogenic health effects.

3.1 DOSE-RESPONSE ASSESSMENT FOR CARCINOGENIC EFFECTS

It has been generally assumed historically that carcinogenic effects are non-threshold effects. This means that any dose, no matter how small, is assumed to pose a finite probability of generating a response. Thus, no dose of a carcinogen is thought to be risk-free. For carcinogenic effects, USEPA uses a two-part evaluation in which the substance is first assigned a weight-of-evidence classification, and then a slope factor (SF) or unit risk (UR) is calculated to reflect the carcinogenic potency.

The weight-of-evidence evaluation involves determining the likelihood that the agent is a human carcinogen. USEPA has developed a system for characterizing the overall weight of evidence for a chemical's carcinogenicity based on the availability of animal, human, and other supportive data (USEPA, 1989). The weight-of-evidence classification rates the likelihood that an agent is a human carcinogen. It qualitatively affects the interpretation of potential health risks. Three major factors are considered in characterizing the overall weight-of-evidence for carcinogenicity: (1) the quality of evidence from human studies, (2) the quality of evidence from animal studies, and (3) other supportive information, such as mutagenicity data and structure-activity data. USEPA's final classification of the overall weight-of-evidence has the following five categories:

Group A - Human Carcinogen This category indicates there is sufficient evidence from epidemiological studies to support a causal association between an agent and human cancer.

Group B - Probable Human Carcinogen This category generally indicates there is at least limited evidence from epidemiologic studies of carcinogenicity to humans (Group B1) or that, in the absence of data on humans, there is sufficient evidence of carcinogenicity in animals (Group B2).

Group C - Possible Human Carcinogen This category indicates that there is limited evidence of carcinogenicity in animals in the absence of data on humans.

Group D - Not Classified This category indicates that the evidence for carcinogenicity in animals is inadequate.

Group E - No Evidence of Carcinogenicity to Humans This category indicates that there is evidence of noncarcinogenicity in at least two adequate animal tests in different species or in both epidemiologic and animal studies.

The ability of a chemical to increase the incidence of cancer in a target population is described by one of two values: the **carcinogenic SF** or the **UR**. Cancer SFs or URs are typically calculated for chemicals in Groups A, B1, and B2. Cancer dose-response values for chemicals in Group C are calculated on a case-by-case basis.

The cancer SF for a chemical is derived by the USEPA's Cancer Risk Assessment Verification Endeavor (CRAVE). Using data derived from animal studies, the SF is an estimate of the upper 95% Confidence Limit of the slope of the dose-response curve extrapolated to low doses.

For some chemicals, human epidemiologic data is the basis of an estimate of the carcinogenic potency, although the most common basis of these values is an animal study. The SF is given in units of $(mg/kg/day)^{-1}$ and is based upon the concept of a lifetime average daily dose. Oral SFs are used to estimate the risks associated with exposure to carcinogens via ingestion. No SFs are available for the dermal route of exposure. Oral SFs are used as surrogates to estimate cancer risks associated with dermal exposure to OHMPCs.

The UR is the upper 95% Confidence Limit of the mean incremental lifetime cancer risk estimated to result from lifetime exposure to an agent if it is in the air at a concentration of 1 mg/m^3.

$$\text{Air Unit Risk} = \text{risk per } \mu g/m^3$$

Inhalation URs are used in this assessment to estimate the incremental risks associated with inhaling carcinogenic OHMPCs in particulate dust emissions (worker exposures to soils) and building air (worker exposures to VOC migration from groundwater).

The dose-response data used in this RA for carcinogenic effects, including SF or UR values, are presented in Tables A4-1 and A4-2 in Attachment 4 for oral and inhalation exposures, respectively.

3.2 DOSE-RESPONSE ASSESSMENT FOR NONCARCINOGENIC EFFECTS

In contrast to carcinogens, noncarcinogens are believed to have threshold exposure levels below which adverse effects are not expected. USEPA has derived standards and guidelines based on acceptable levels of exposure for such compounds. Noncarcinogenic effects of concern on which many of the standards and guidelines are based include liver toxicity, reproductive effects, neurotoxicity, teratogenicity, and other chronic toxicities. Various criteria have been developed from experiments that can be used to estimate the dose-response relationship of noncarcinogens. Some of the same uncertainties involved in deriving cancer risk estimates (namely, selection of an appropriate data set and extrapolation of high-dose animal data to low-dose human exposure) are also involved in deriving noncarcinogenic dose-response criteria. Dose-response values used most often to evaluate noncarcinogenic effects are reference doses (RfDs).

The RfD, expressed in units of mg/kg/day, is defined as an estimate (with uncertainty spanning perhaps an order of magnitude or greater) of a daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during a lifetime (USEPA, 1989). When available, the RfD is the dose-response criterion most appropriate for quantitatively estimating noncarcinogenic effects. The RfD is derived from the following equation:

$$\text{RfD (mg/kg/day)} = \frac{\text{NOAEL or LOAEL}}{\text{U.F. and/or MF}}$$

The No Observable Adverse Effect Level (NOAEL) represents the dose of a chemical at which there are no statistically or biologically significant differences in the frequency of an adverse effect between the exposed population and its appropriate control. The Lowest Observable Adverse Effect Level (LOAEL) represents the lowest dose at which a statistically significant difference in the frequency of an effect is noted. Both the NOAEL and the LOAEL are reported in terms of mg/kg/day. An uncertainty factor (UF) of ten per type of uncertainty is used to account for interspecies and intraspecies differences, severity of the adverse effect, whether the dose was an NOAEL or an LOAEL, and the adequacy of the data. The magnitude of the UF will therefore vary from chemical to chemical, ranging from 10 to 10,000. A modifying factor (MF), ranging from less than 0 to 10 may also be added to reflect qualitative uncertainties not explicitly addressed in the UFs. The toxicity endpoint upon which the RfD is derived and the UF and/or MF used in the calculation are presented in the dose-response tables.

No RfDs are available for the dermal route of exposure. Risks associated with dermal exposure are evaluated using oral RfDs.

The reference concentration (RfC, in units of mg/m^3) is analogous to the RfD and is developed through a similar process. However, unlike RfDs, which represent a dosage (in mg/kg/day) at which adverse or deleterious effects are unlikely, RfCs represent air concentrations (in mg/m^3) at which adverse or deleterious effects are unlikely (i.e., an air concentration corresponding to an HI = 1). Non-carcinogenic risks due to inhalation exposures are estimated by comparing the environmental air concentration to the inhalation RfC. RfCs may be converted to a corresponding inhaled dose for an adult (an inhalation RfD, in units of mg/kg-day) by dividing by 70 kg, and multiplying by an inhalation rate of 20 m^3/day. Because USEPA cautions that the appropriateness of doing this conversion must be evaluated on a case-by-case basis, ABB-ES has determined that it is more appropriate to use RfCs directly to estimate inhalation non-cancer risks (as opposed to converting RfCs to RfDs for the purposes of estimating inhalation risks). Use of RfCs as opposed to derived RfDs is likely to reduce the uncertainty of the risk estimates generated for the inhalation exposure pathway.

The use of chronic RfDs and RfCs to evaluate the potential for adverse health effects resulting from substantially less-than-lifetime exposures may be overly protective. Subchronic Reference Doses and Subchronic Reference Concentrations (RfD_s/RfC_s) have been developed for many chemicals to evaluate the potential noncarcinogenic effects of limited duration exposures (between two weeks and seven years). RfD_s/RfC_s are similar to chronic RfDs/RfCs; the distinction is the length of exposure duration. When available, RfD_s/RfC_s are used in this risk assessment to evaluate noncarcinogenic effects to a utility worker and a construction worker for an exposure duration of two weeks and eight weeks, respectively. When RfD_s/RfC_s are unavailable, chronic RfDs/RfCs are used to evaluate noncarcinogenic effects for these receptors.

Dose-response data for noncarcinogenic effects (RfDs or RfCs) and their critical toxic effects, are presented in Tables A4-3 and A4-4 (oral and inhalation exposures, respectively) in Attachment 4 for chronic and subchronic effects.

3.3 SOURCES OF DOSE-RESPONSE VALUES

The main source of dose-response values is the USEPA Integrated Risk Information System (IRIS) which is a data base established by USEPA containing all validated data on many toxic substances found at hazardous waste sites. This data base was used to identify the SFs and RfDs applied in this risk assessment. Where no information was found in IRIS, USEPA Health Effects Assessment Summary Tables (HEAST) were used. When toxicity values from IRIS or HEAST were not available, alternative toxicity values available from USEPA or MADEP sources were used. The hierarchy of sources used to obtain dose response data for carcinogenic and non-carcinogenic effects, per MADEP guidance (1995a), is as follows:

<u>SFs and URs</u>:

1) IRIS; current as of January, 1997 (USEPA, 1997)
2) HEAST; current as of fiscal year 1995 (including July updates) (USEPA, 1995a; 1995b)
3) California Environmental Protection Agency (CALEPA, 1994)

<u>Reference doses and reference concentrations:</u>

1) IRIS; current as of January, 1997 (USEPA, 1997)
2) HEAST; current as of fiscal year 1995 (including July updates) (USEPA, 1995a; 1995b)
3) Toxicity values developed by MADEP, ORS (MADEP, 1992; 1994)

4) Agency for Toxic Substances and Disease Registry (ATSDR) Toxicity Profile Documents (ATSDR)
5) Allowable threshold concentrations (ATCs) developed by MADEP (MADEP, 1995b)
6) Dose-response values used to develop drinking water standards and guidelines or back-calculated from drinking water standards and guidelines (USEPA, 1996)

RfDs and RfCs are provided in IRIS, HEAST, and by MADEP ORS. In addition, RfDs used to develop drinking water standards and guidelines for some chemicals are provided in USEPA's "Drinking Water Regulations and Health Advisories" (USEPA, 1996). For some chemicals, ATSDR publishes minimal risk levels (MRLs) for threshold effects via the oral or inhalation exposure route. MRLs are derived using the modified risk assessment methodology the USEPA uses to derive RfDs and RfCs. MRLs were used as surrogate RfDs and RfCs when these values were not available in IRIS, HEAST or MADEP sources. ATCs are derived from threshold effects exposure limits (TELs), which represent 20% of the allowable dose. Therefore, ATCs were developed by multiplying the TEL by five, as described in MADEP (MADEP, 1995b). ATCs were used as surrogate RfCs when RfCs were not available in other sources.

An RfD developed by ABB Environmental Services, Inc. (ABB-ES) for the two isomers of 2,4,4-trimethylpentene (diisobutylene) was also used. Documentation for the 2,4,4-trimethylpentene value is presented in Attachment 4. In addition, ABB-ES developed RfDs for Opex™ and Kempore™. The documentation for these RfDs is contained in Attachment 4. Finally, an RfD for cobalt developed by USEPA's National Center for Environmental Assessment (NCEA) is used in this assessment. The documentation for this RfD is provided in Attachment 4.

SECTION 4.0

4.0 EXPOSURE ASSESSMENT

As currently defined by the USEPA (USEPA, 1992), exposure to a chemical is the contact of that chemical with the outer boundary of the body (i.e., skin and openings such as mouth, nostrils, or punctures and lesions). An exposure assessment is the quantitative or qualitative evaluation of that contact. It describes the intensity, frequency, and duration of contact, as well as the rates at which the chemical crosses the boundary (chemical intake or uptake rates), the route by which it crosses the boundary, and the resulting amount of chemical that actually crosses the boundary (a dose) and the amount absorbed (internal dose).

This exposure assessment consists of several components, including identification of: current and future land use and limitations on use; human receptors; exposure points; exposure routes; soil and groundwater MCP categories exposure point concentrations; and daily doses or average exposure concentrations.

4.1 IDENTIFICATION OF POTENTIAL HUMAN RECEPTORS, EXPOSURE POINTS, AND EXPOSURE ROUTES

An exposure pathway describes the course a chemical takes from the source to the exposed individual. Exposure pathway analysis links the sources, locations, and types of environmental releases with population locations and activity patterns to determine the significant pathways of human exposure.

Exposure pathways generally consist of four elements: (1) a source and mechanism of chemical release, (2) a retention or transport medium, (3) a point of potential human contact with the contaminated medium (known as the exposure point), and (4) an exposure route at the contact point (USEPA, 1989).

4.1.1 Description of Current Site Use

The Facility is located in an area that is zoned as General Industrial. It is surrounded to the east, north, and west by industrial facilities and to its immediate south by the Woburn Town Dump. Land use further to the west of the Facility and to the northeast is residential. The entire Facility is enclosed by an 8-foot-high chain link fence that is secured when the Facility is unattended. Thus, only On-property workers and utility workers are expected to be exposed to OHM located within the fenced perimeter of the Facility for current land use. No exposure to drummed waste On-property is expected under current site use because that material is in the subsurface in a restricted area of the facility. Current use of the Facility and bordering properties is industrial. Because the Facility is enclosed by a secured 8-foot-high fence, trespassing on the property under current site use is not anticipated. However, exposure of neighborhood residents to impacted surface water and sediments located outside the perimeter fence is currently possible.

Groundwater directly underlying the Facility is not used for potable or industrial purposes. To the west of the Facility, groundwater is used by one company, Altron Corporation, as process water. Further to the west, a number of residents along Border and Cook Avenues have private wells. These wells are not hydraulically connected to the groundwater impacted by the disposal site. Several residences on Main Street to the west have abandoned their private drinking water wells and are currently connected to the Town of Wilmington Public Water Supply. These properties also have in place or planned Notices of Limitation with Respect to Groundwater that will prevent use of or installation of private wells. No residences downgradient of the Facility currently use private wells for potable purposes. However, two properties, listed as M-25/L-12 and M-25/L-9, have non-potable private wells that are not currently in use. Negotiations are currently underway for abandonment of those wells and Notices of Limitation with respect to groundwater. The well at property M-25/L-12 was previously used to fill a swimming pool. However, the owner has reported this well has not been used for the last two years. The Town of Wilmington well fields at Chestnut Street, Butters Row, and Town Park are located approximately one-half mile northwest of the Facility. These well fields contribute to the Town of Wilmington drinking water system.

4.1.2 Description of Foreseeable Future Site Use

Limitations on future activities and uses

Limitations on future activities and land and groundwater use have been incorporated into the exposure assessment for the site. Notices of Limitation With Respect to Groundwater are in place for several properties along Main Street west of the site and all private drinking water wells downgradient of the Facility have been abandoned. In addition, several industrial properties west of the site have been granted Downgradient Property Status (DPS) relative to OHM released at the site. Maintenance of the DPS is contingent upon owners/operators maintaining compliance with a DPS Status Groundwater Management Plan.

An ongoing groundwater interceptor system in place in the Plant B area contains non-aqueous phase processing oil and the groundwater, preventing discharge of OHM from the groundwater to the East Ditch. It is assumed here that this system will remain in place until such time that there is no longer a threat of release associated with the area and therefore there is no foreseeable future exposure to OHM in the groundwater in the Plant B area.

There is also a notice of Activity and Use Limitations (AULs) in preparation that will apply to the Facility property, preventing activities and uses that would be inconsistent with the findings of this risk assessment. These various limitations are described below. Copies of typical Notices, Opinions and associated information are found in Attachment 3, Limitations on Site Activities and Uses.

Private wells - Main Street. As a temporary risk reduction measure at downgradient residential properties, existing private drinking water wells (if any existed) have been abandoned, residences have been connected to the public water supply, and Notice of Limitations With Respect to Groundwater are in place or planned to insure no additional wells are installed at these residential properties. The wells at two properties (M-25/L-12 and M-25/L-9) are not drinking water wells, are not used currently, and have not yet been abandoned. The well at property M-25/L-12 was previously used to fill a swimming pool, but the resident reports it has not been used the last two years. Olin is currently negotiating abandonment of those wells. The Notice and accompanying Opinion from a Licensed Site Professional apply to residential properties, identified by real estate map number and lot number on Figure 10, as M-26/L-7A, M-26/L-6, M-26/L-5, M-26/L-4, M-26/L-3, M-25/L-13, M-25/L-12, M-25/L-11, M-25/L-10, M-25/L-9, M-25/L-8, M-25/L-7, M-25/L-6 and M-25/L-5. These properties are the only residential properties located in the area of the deep, dense layer (plume) that has migrated to the west of the site. All residents listed have been provided draft copies of Notices and Opinions, and have been given the opportunity to participate in the program with compensation provided.

The use of or installation of private water supply wells for drinking water or any other purpose (with some exceptions related to testing of the water) at these residential properties along Main Street west of the site is restricted by the Notice of Limitation With Respect to Groundwater. Notices were issued in conjunction with an LSP's Groundwater Limitation Opinion. Examples of the NOL and LSP's Groundwater Limitation Opinion are presented in Attachment 3.

Another factor that limits future groundwater use at the residential properties is that installation of new residential wells would require prior approval by the Town of Wilmington Board of Health per the Board of Health Code of Regulations, Section 6. Since the Board is aware of the groundwater issues and has the responsibility to protect the public health, it is extremely unlikely the board would approve of new wells. In a recent draft guidance document (MADEP, 1997), the MADEP indicates that in such circumstances, the installation of new private wells is otherwise adequately regulated, and separate mechanisms to prevent installation of new private wells would not be necessary with respect to the MCP. Although this is not official policy, it does provide an indication of the agency's current thinking on this matter. Therefore, for current land use, there are no downgradient properties with potable wells and measures have been taken to insure that no private residential wells will be installed at downgradient properties.

There is no indication that there is or will be a shallow groundwater impact in residential areas west of the site. Therefore, there is no potential for vapor migration from shallow groundwater in that area into occupied buildings. With the Notice in place, there is no current or foreseeable exposure to groundwater at these properties. This Notice of Limitation With Respect to Groundwater has been reviewed by officials in the MADEP's Woburn office, who agreed that this mechanism could be used as a means of preventing groundwater exposure as a preliminary response action (MADEP, 1996c).

Permitted uses of the properties with NOLs include all current uses and testing of water from monitoring wells as deemed necessary by an LSP. Activities and uses inconsistent with the LSP's Groundwater Limitation Opinion include: removal of sealant or other substance used in abandoning the private water supply wells; installation of a water supply well within the property; withdrawal of groundwater for any purpose other than sampling or testing without prior notification of MADEP to determine if approval is necessary; drilling or otherwise accessing the subsurface at a depth greater than 30 feet without prior notification to MADEP to determine if approval is necessary. The owner/operators have an obligation to maintain compliance with the conditions of these limitations on activities and uses with respect to groundwater at the property. The provisions of the Notice of Limitation With Respect to Groundwater have been incorporated into and will run with deeds, mortgages, leases, and any instruments of transfer.

<u>Industrial Properties - West of the Facility</u>. Limitations with respect to groundwater use by owners/operators of industrial properties have been assumed in the risk assessment. It has been assumed that, with the exception of the Altron facility that currently has two operating wells that extract groundwater for non-potable, industrial use, none of the downgradient industrial properties within the boundaries of the disposal site would install and use wells that would result in human exposure to site-related constituents. This assumption is based on the following information: there is only one downgradient industrial property that uses groundwater for non-potable purposes; Olin has informed all of the downgradient property owners of the contamination; DPS, with an associated

groundwater management plan, will be achieved at most, if not all of the properties identified on Figure 11; the Town of Wilmington's health regulations prohibit the installation of any well without permission from the Board of Health; the Board of Health may deny a permit when public health might be at risk; the Board of Health has been informed of the contamination and is unlikely to allow installation of a well that would access the contamination; the properties are currently connected to the Public Water Supply. All of these factors, in combination, suggest that installation of wells on these industrial properties with associated human exposure is not a reasonably foreseeable use of the groundwater in this area. It is also assumed groundwater will not be put to potable use, since the groundwater in this area is categorized as GW-2 and GW-3.

Notice of DPS and an associated LSP's Downgradient Property Status opinion have been offered by Olin to owners/operators of industrial properties, identified by map number and lot number per Figure 11, as M-24/L-207, M-24/L-208, M-24/L-208B, and M-24/L-209A (related to both shallow and deep groundwater) and M-24/L-205, M-24/L-206, M-24/L-31A, M-24/L-31C, M-24/L-31D, M-24/L-33A, M-38/L-1, M-38/L-2, and M-26/L-2 (related to deep groundwater). These properties are the only industrial properties located in the area where impacted groundwater has migrated to the west of the site. With the Notice in place, current and foreseeable direct exposures to groundwater at these properties controlled. Indirect exposures, such as vapor migration, are evaluated as part of the risk assessment.

The Notice of DPS includes a DPS Groundwater Management Plan. The purpose of the Management Plan is to prevent the exposure of human and environmental receptors to hazardous material at the downgradient property that is subject to the DPS, prevent an act by the owner/operator of the DPS property to cause the release to become worse than it otherwise would be, and avoid an activity that could prevent or impede the implementation of reasonably likely response actions in the future. Activities and uses inconsistent with the LSP's DPS Opinion include the use of groundwater for potable purposes and uses of groundwater that are inconsistent with the above-stated purpose of the DPS Groundwater Management Plan. The owners/operators have an obligation to maintain compliance with the conditions of the Notice of DPS and the associated Groundwater Management Plan in order to maintain the DPS. Examples of the Notice of DPS and the LSP DPS Opinion are provided in Attachment 3.

<u>Facility Property - Activity and Use Limitation</u>. In the foreseeable future, use of the Facility and the surrounding land is anticipated to remain industrial/commercial. Future activities and uses of the Facility property are to be limited by a Notice of AUL that will apply to the Facility property at 51 Eames Street. The Notice will be issued in conjunction

with an LSP's AUL Opinion. The Notice and Opinion apply to the property at 51 Eames Street, identified by map number and lot number on Figure 12, as M-37/L-2, M-37/L-10, M-37/L-14, M-37/L-16, M-37/L-19, M-37/L-20 and M-37/L-21. The current use of the former industrial property is office space. Property maintenance activity is associated with the unused portions of the site. The AUL identifies the following activities and uses as being inconsistent with the AUL Opinion: use of the property for residential purposes, for schools, for daycare facilities, for active recreational purposes, for retail or wholesale commercial use; excavation of surface or subsurface soil or other materials in the Sulfate Landfill; excavation of subsurface soils (deeper than 3 feet bgs) and placement of same at the soil surface; excavation within hot spot areas identified on Figures 15 and 16 without an evaluation of risks supervised by an LSP; installation of a water supply well within the property; and withdrawal of groundwater for any purpose other than sampling, testing, or containment/treatment. Most of these activities and uses that are identified as inconsistent with the AUL opinion are identified as such because the risk assessment has not specifically evaluated the risk for those potential future uses. It is possible, that upon further risk evaluation, one or more of those uses or activities may be determined to be consistent with the requirements of the MCP.

Permitted uses of the properties include all current uses (e.g., for office space) and active industrial use of the entire property. Excavation in non-hot spot areas by utility and construction workers is permitted provided that the excavation is conducted in a manner consistent with the performance standards for Utility-related Abatement Measures (URAMs) set forth by the MCP at 310 CMR 40.0460, the soil management procedures pursuant to 310 CMR 40.0030, and/or all applicable worker health and safety practices per 310 CMR 40.0018 and provided that soils excavated from a depth of greater than three feet bgs are not left in place on-site at a depth of less than three feet bgs. Other activities and uses not specifically prohibited would be permitted. Other activities and uses that, in the opinion of an LSP, would present no greater risks than the permitted uses identified here would also be permitted. Such uses might include some uses identified above as inconsistent with the AUL Opinion, provided the associated risks were demonstrated to be within MCP requirements in an assessment supervised by an LSP. The owners/operators have an obligation to maintain compliance with the conditions of these limitations on activities and uses with respect to soil and groundwater at the property. The provisions of the Notice of AULs will be incorporated into and will run with deeds, mortgages, leases, and any instruments of transfer.

It is possible that the fence enclosing the Facility could be removed or fall into disrepair. Therefore, future exposure of neighborhood residents to soils, sediments, and surface water within the fenced perimeter of the Facility is possible. In addition, if construction of new structures was required, construction workers could be exposed to OHM in subsurface soils in non-hot spot areas.

The Notice of Limitation with Respect to Groundwater and the Notice of DPS described above restrict or control use of groundwater by downgradient residential and industrial property owners/operators. There is currently no On-property use of groundwater for potable or non-potable purposes. No use of groundwater within the property boundaries will be permitted per the terms of the AUL for the property as described above.

Wilmington Public Water Supply/Butters Row Treatment Plant - It is assumed in this assessment that the two Butters Row wells, the two Chestnut Street wells, and the Town Park well will continue to operate for the foreseeable future. It is also assumed that the Butters Row Treatment Plant will also continue to operate for the foreseeable future. The treatment plant currently conducts various treatments of the combined waters of the five above-mentioned supply wells to contribute to the Butters Row Treatment Plant. These water treatments are necessary to the delivery of suitable drinking water to Wilmington residents and the treatments are required independent of any contaminants related to the Olin Facility.

Water treatment at the Butters Row Treatment Plant includes aeration of incoming water for removal of trichloroethene and carbon dioxide (not related to the Olin Facility), pH adjustment with lime, potassium permanganate oxidation, flocculation, settling and filtration (all for removal of naturally occurring iron and manganese) and final pH adjustment with lime and chlorination (required disinfection). All of these processes are part of the treatment plant design and are expected to continue for the foreseeable future. Although MADEP guidance suggests that public water supplies should be evaluated under the assumption that treatment is not in place, the assumptions made here are realistic and accurately represent foreseeable future conditions. Therefore, these assumptions are consistent with MCP risk characterization requirements. There is no realistic foreseeable situation that would not include removal of iron and manganese (with aeration as a pretreatment step) from incoming groundwater as well as chlorination for disinfection purposes that is required by Federal drinking water regulations. Even if the Butters Row Treatment Plant were upgraded in the future, these groundwater treatment processes would continue. The continued treatment of the groundwater plays an important role in the exposure assessment for both current and future conditions as discussed in the following exposure assessment.

An additional future exposure pathway is the potential for exposure to the Town of Wilmington public water supply, whose wells are located about one-half mile to the west of the Facility. Based on existing data, the inorganic plume associated with the disposal appears to be moving very slowly, if at all. Disposal of material into unlined pits/lagoons and the Lake Poly Liquid Waste Disposal Area began in about 1953 and continued until a treatment plant was installed and connected to the Metropolitan District Commission sewer in 1972. Even though the materials were discharged more than 40 years ago and discharge has been discontinued for 25 years, the migration has been limited in extent. There is not an imminent threat to the town supply wells. The slope of the bedrock surface is a factor in the migration of this material. It is likely that migration of the material slowed with time due to flattening of the bedrock slope away from the disposal area. The cessation of disposal would also have resulted in a decrease in driving head for migration of the denser material. In addition, the geochemical behavior of the inorganic material results in the precipitation of some constituents.

Additional data necessary to provide an understanding of the behavior and potential for migration of the inorganic plume have been collected. Using that information, groundwater contaminant fate and transport modeling have been conducted to estimate conservatively whether any further impact to Town of Wilmington water supply wells might be expected in the absence of any intervention. The modeling results have been used to evaluate that future exposure pathway.

Available data indicate that the finished water leaving the treatment plant is in compliance with all Massachusetts Primary Drinking Water Standards. Sodium concentrations are typically above the Massachusetts Drinking Water Guideline of 20 mg/L.

The Supplemental Phase II Report has concluded that constituents (ammonia, sulfate and chloride) of the dense layer in the groundwater are present in two of the public supply wells. The two affected wells are Butters Row #1 and Chestnut Street #1. However, the concentrations of these analytes found in those two wells are below corresponding Massachusetts Drinking Water Standards and Guidelines. Although these constituents have been detected in the water in these two wells, no one is currently drinking water directly from those wells. Water from those wells is pumped to the Butters Row Water Treatment Plant, where it is combined with water from Butters Row #2, Chestnut Street 1A/2, and Town Park wells prior to treatment.

4.1.3 Identification of Potential Human Receptors

Human receptors are the theoretical individuals who might be exposed to site contaminants and for which risks of adverse effects (carcinogenic and non-carcinogenic) are estimated in the Risk Characterization section. Receptors are chosen in order to cover the entire range of potential exposures (exposure media and exposure routes) and to identify the maximally exposed individual in the receptor group. The exposure assessment targets average exposure for the maximally exposed individual (MADEP, 1995a).

The MCP requires that all exposure pathways for each potential receptor be identified. The human receptors who could be exposed to contamination at or resulting from the Wilmington site under current use are:

- Neighborhood resident to the west of the site who consumes Town drinking water and who may play in surface water and sediments outside of the fenced perimeter of the Facility
- Neighborhood resident to the east of the site who consumes Town drinking water and who may play in surface water and sediments outside of the fenced perimeter of the Facility
- On-property worker
- Worker at an adjacent industrial property
- On-property Utility worker

The receptors listed under current use could also be exposed under future use. Additional future receptors include:

- On-property Construction worker
- Full time, long-term On-property industrial worker
- Neighborhood resident who consumes Town drinking water, who may play in surface water and sediments (both on and off the Facility property), and who may contact surface soils within the perimeter of the Facility

The future land use scenarios include a complete exposure pathway associated with the Town drinking water. Table 8 presents the potential receptors and exposure pathways for current and future uses of the site and surrounding area and identifies those pathways that are or might be complete and therefore are evaluated quantitatively in the risk assessment.

4.1.3.1 Soil and Groundwater Categorization

In accordance with 310 CMR 40.0930, soil and groundwater are categorized using the MCP Subpart I criteria as part of a Method 3 Risk Characterization. Groundwater categories are used to identify applicable or suitably analogous standards when Method 3 is used to characterize risk. The soil and groundwater categories are used to guide the development of exposure profiles for the risk assessment. Additionally, the groundwater and soil categories selected for a site are considered in determining the need for an AUL as part of a Response Action Outcome in accordance with 310 CMR 40.1012 and 310 CMR 40.1070 through 40.1089.

Three soil categories have been identified in 310 CMR 40.0933. Soil is classified into either category S-1, S-2, or S-3 based on site, receptor, and exposure information. While only one category is applicable to a specified volume of soil, soils in different areas of a disposal site may be classified in different categories, depending on their exposure potential. Category S-1 soils are associated with the highest potential for exposure, while category S-3 soils have the lowest potential for exposure. The potential for exposure to soil is described by a qualitative analysis of the accessibility of the soil in combination with information concerning frequency and intensity of exposure for site activities and uses. Potential exposures to children, adults, and environmental receptors are to be considered in identifying categories.

Based on the classification scheme described in 310 CMR 40.0933(5), (6), and (7), unpaved surface soil (0-3 feet bgs) is classified as S-3 and paved surface soil (0-3 feet bgs) at the Site is classified as S-3 for current exposures for the following reasons:

- soil is either "accessible" because contamination is located in samples within 3 feet of the surface and it is not covered by pavement or it is "potentially accessible" because there is contamination within the 3 feet of the surface and the surface is covered by pavement;
- exposure is expected to be of low intensity for adults only;
- exposure is expected to be of low frequency for adults only.

Based on the classification scheme described in 310 CMR 40.0933 (5), (6), and (7), subsurface soil (greater than 3 feet bgs) in unpaved areas and subsurface soil (greater than 3 feet bgs) in paved areas at the Site is classified as S-3 for current exposures for the following reasons:

- subsurface soil is either "potentially accessible" because contamination is located in samples between 3 and 15 feet bgs and it is not covered by pavement or there is contamination between 3 and 15 feet bgs and the surface is covered by pavement;
- exposure is expected to be of low intensity for adults only;
- exposure is expected to be of low frequency for adults only.

All soils found at greater than 15 feet bgs are classified as "isolated" and are therefore classified as S-3 soils for current and future land uses.

Based on current information and intended AUL the expected future use of the site is industrial or inactive. While in the future, trespassers may enter the site, more frequent or more intense activities by trespassers (adolescents) or adults would be prohibited, except as provided for utility or construction-related excavation activity. Other activities that could disturb soil, such as recreational sports or play areas, would be excluded without further risk evaluation.

Based on the classification scheme described in 310 CMR 40.0933(5), (6) and (7), unpaved surface soil (0-3 feet bgs) is classified as S-2 and paved surface soil (0-3 feet bgs) at the Site is classified as S-3 for future exposures for the following reasons:

- soil is either "accessible" because contamination is located in samples within 3 feet of the surface and it is not covered by pavement or it is "potentially accessible" because there is contamination within the 3 feet of the surface and the surface is covered by pavement;

- exposure is expected to be of low intensity for adults and children and possibly high intensity for adult excavation workers;

- exposure is expected to be of low frequency for adults and children (except the full-time, long-term industrial worker).

Based on the classification scheme described in 310 CMR 40.0933(5), (6), and (7), subsurface soil (greater than 3 feet bgs) in unpaved areas and subsurface soil (greater than 3 feet bgs) in paved areas at the Site is classified as S-3 for future exposures for the following reasons:

- subsurface soil is "potentially accessible" because contamination is located in samples between 3 and 15 feet bgs (paved and unpaved) and utility or construction-related excavation would not be prohibited; however, bringing those soils to the surface and allowing them to remain at the surface would be prohibited.

- exposure is expected to be of high intensity for adult excavation workers (no children present during that activity);

- exposure is expected to be of low frequency for adult excavation workers (no children present during that activity).

MCP soil categories for On-property soils are shown on Figure 13.

Three groundwater categories are described in 310 CMR 40.0932. Groundwater category GW-1 applies to groundwater that is or may reasonably be expected to be used as a source of potable water or is in close proximity to a public or private water supply. Groundwater that is within 30 feet of an occupied existing structure and has an average annual depth to the water table of less than or equal to 15 feet, is in category GW-2. Groundwater in category GW-2 is considered a potential source of vapors to indoor air. All groundwater under evaluation is classified as category GW-3. Groundwater in category GW-3 is considered a potential source of discharge to surface water. More than one groundwater category may be determined to be applicable.

Groundwater categories GW-2 (in areas with occupied buildings as shown on Figure 14) and GW-3 are considered to be potentially applicable to groundwater beneath the Facility property. Due to the proximity of groundwater with an average annual depth of less than 15 feet to potentially occupied buildings, and the likelihood that Site groundwater discharges to surface water at and adjacent to the Facility property, groundwater beneath the Facility property has been classified as categories GW-2 and GW-3 for the purposes of this Risk Characterization. (Strictly speaking, the GW-2 category applies only to the currently occupied building. Assignment of the GW-2 category to the area of the remaining unoccupied buildings is done to provide additional perspective concerning future land use.) Most of the groundwater beneath the Facility property is not classified as GW-1, according to the Mass-GIS map (MADEP, 1996d). The area beneath the property is not a high-yield aquifer, it is not within 500 feet of a private drinking water supply, and the site is within 500 feet of a municipal water supply distribution system.

Groundwater categories GW-1, GW-2, and GW-3 are applicable to groundwater within the area of the disposal site boundary to the west of the Facility property. The GW-2 portion of that area is small, because there is not groundwater contamination within 15 feet of the land surface in most of the area where the dense layer has been identified west of the Facility. As shown on Figure 14, a large portion of this contaminant plume is within the Zone II of the Town of Wilmington Water Supply Wells (IEP, 1990; MADEP, 1996d); this portion is categorized as GW-1 per 40.0932 (4)(a).

Occupied industrial and residential buildings that are not on the facility property are within the contaminant plume area where depth to groundwater is less than 15 feet. However, site-related volatile OHM are present in shallow groundwater only on the property in the industrial area just west of the Facility, not in the residential area along Main Street. Therefore, only the groundwater beneath the Facility and the industrial properties in that immediate area is categorized as GW-2 and evaluated for the potential migration of vapors from groundwater into buildings.

4.1.4 Identification of Exposure Points and Exposure Routes

As defined in the MCP, an exposure point is the location of potential contact between a human or environmental receptor and a release of OHM. An exposure point may describe an area or zone as well as a single point. Exposure routes include ingestion, dermal contact, and inhalation. Potential exposure points and exposure routes were identified for surface soil, subsurface soil, groundwater, surface water, sediment, and air.

Due to the presence of numerous hot spots and differential opportunity for site access under current and future land uses, there are multiple exposure points for each of the media evaluated at this site. The identification of exposure points has been accomplished by first identifying any hot spots in each medium, identifying any differential opportunity for site access between current and future land uses, and by identifying any differential opportunity for access to released OHM among the different portions of the disposal site.

Hot Spot Analysis. Consistent with the MCP (310 CMR 40.0924(2)) and the Guidance For Disposal Site Risk Characterization (MADEP, 1995a), discrete areas of contamination that meet the MCP definition of a hot spot (310 CMR 40.0006) should be evaluated as additional, individual exposure points. Therefore, it is important to identify hot spots in various environmental media prior to identification of the final list of exposure points. According to the guidance, an elevated concentration at a single sample location does not necessarily constitute a hot spot. For soil, the exposure point is determined by the horizontal and vertical distribution of contamination and the applicable soil categories. When a contiguous volume of contaminated soil has more than one soil category within it, the soil in each category is considered a separate exposure point. Separating surficial (0-3 feet bgs) and subsurface soil (3-15 feet bgs) accomplishes this separation for this site. Taken together, surface and subsurface soil hot spots consider both horizontal and vertical distribution of OHM in soil.

For this Risk Characterization, hot spot identification is accomplished through a comparison of the medium-specific arithmetic mean concentration of each analyte in a particular potential hot spot to the arithmetic mean concentration of that analyte in areas without potential hot spots. If the mean concentration in a potential hot spot is less than ten times the mean concentration in non-hot spot areas, then no hot spot is present. If the mean concentration in a potential hot spot is greater than ten times the mean concentration in the non-hot spot area, that discrete area will be considered a hot spot. No additional statistical evaluation of potential hot spots was conducted.

Potential hot spots were identified by reviewing the data for each medium, identifying the location of the highest concentrations of each analyte, and identifying sampling locations that might represent discrete areas of elevated concentrations (while also considering known or suspected sources of OHM release) and then plotting those areas on a figure. Mean concentrations of each analyte in each potential hot spot and in the areas without hot spots (non-hot spot areas) were calculated and compared. The hot spot criteria discussed above were applied to identify hot spots. Those analytes that met the hot spot criteria were also identified for each hot spot. This evaluation is presented in Tables 9 through 14. These tables identify confirmed hot spots and identify the OHM that meet the hot spot definition for each of those hot spots. The confirmed hot spots and associated hot spot analytes are summarized in Table 15. Figures 15 through 23 show all exposure points for each medium, including the potential/confirmed hot spots. Each of the confirmed hot spots is considered a separate exposure point in addition to the exposure points identified in the following discussion of the specific receptors, exposures routes, and exposure points. The sample locations and sample numbers associated with each of the hot spots and other exposure points are identified in Attachment 1.

Exposure routes and exposure points are presented in the following sections and summarized in Table 8 and Table 16, respectively.

4.1.4.1 Surface Soil

Exposure points identified for surface soil include the six hot spots (Grid Area 8, Drum Area A, Lake Poly Liquid Waste Disposal Area, SWMU-27, SWMU-30 and SWMU-33), the Sulfate Landfill, the non-hot spot area on the portion of the site with buildings, and the non-hot spot area on the portion of the site without buildings. These exposure points are identified on Figure 15. The surface soil exposure points encompass all locations where OHM have been identified in surface soil. Under current and future use, an On-property worker and a utility worker could be exposed to surface soil through ingestion and direct contact and inhalation of respirable dust while performing maintenance activities. In the future, if the perimeter fence was removed, a neighborhood resident could be exposed to surface soil through ingestion and direct contact while trespassing on the Olin Facility. In the future, construction workers could be exposed to surface soil via incidental ingestion, dermal contact, and inhalation of respirable dust. Receptors On-property (either workers or trespassers) could also be exposed to contaminants in surface soils via inhalation of wind-eroded particles. Volatilization of organic compounds from soil to air was not considered to be significant because of the low level of volatile organic compounds in surface soils. All receptors evaluated here may be exposed at all of the identified exposure points. Sample locations and sample numbers included in each hot spot and other exposure points are identified in Attachment 1.

4.1.4.2 Subsurface Soil

Exposure points identified for subsurface soil include the five hot spots (Drum Area B, Drum Area A, Lake Poly Liquid Waste Disposal Area, Former Lagoon Area, and Plant B), the Sulfate Landfill, and the remainder of the non-hot spot areas on the site. These exposure points are identified on Figure 16. The subsurface soil exposure points encompass all locations where OHM have been identified in subsurface soil. Sample locations and sample numbers included in each hot spot and other exposure points are identified in Attachment 1. Under current and future use, a site utility worker could be exposed to subsurface soil directly through ingestion, direct contact, and inhalation of vapors and respirable dust. In the future, a construction worker could also be exposed through the same routes. Subsurface soils in all areas of the site are considered equally accessible to utility workers and construction workers, with the exception of the Sulfate Landfill. An AUL restricts excavation in that area.

4.1.4.3 Groundwater

Exposure points identified for groundwater have been identified in two categories, Zone II groundwater and non-Zone II groundwater. For current land use, exposure points related to potentially complete exposure pathways for groundwater include a shallow groundwater hot spot for volatiles (the groundwater in this hot spot is classified as GW-2 and GW-3 groundwater) that has potential vapor migration into buildings, the two operating non-potable wells (B-1 and B-3) at the Altron facility, and theoretically, each of the monitoring wells within the Zone II of the Wilmington water supply wells, Butters Row Well #1 and Chestnut Street Well #1, and the Town of Wilmington supplied water from the Butters Row Treatment Plant. Figure 3-7 of the Phase II Supplemental Report and Figure 18 of this RA delineate the MADEP-approved wellhead protection zone (Zone II). For current and future land use, the Butters Row Treatment Plant's water distribution system is a potential exposure point. It should be noted that no one is actually exposed to untreated water from either of the two supply wells, Butters Row Well #1 and Chestnut Street Well #1, that exhibit impacts by the Site or from the monitoring wells within the Zone II. Risks associated with use of groundwater as drinking water are therefore, calculated only for finished water leaving the

Butters Row Treatment Plant. This is the only realistic exposure point for current and future conditions associated with the Site.

Figure 17 shows the current and foreseeable future exposure points for the non-Zone II groundwater. Figure 18 shows the current and foreseeable exposure points for Zone II groundwater. Sample locations and sample numbers included in each of the hot spots and other exposure points are identified in Attachment 1.

As discussed in Section 4.1.2 above, under current use, there is no exposure to groundwater from private wells for neighborhood residents. All drinking water wells have been abandoned, all residents have been notified, the NOL is in place or anticipated, and the Town Board of Health would be unlikely to approve installation of new wells and the conditions of the Notice of Limitation With Respect to Groundwater (this notice also applies to the property identified on tax maps as M-25/L-12, which previously used a private well to fill a swimming pool and M-25/L-9) prevents exposures. No residences that are not addressed by this Notice are in areas where private wells might be impacted by the site. There is currently a complete exposure pathway with respect to the Town of Wilmington water distribution system because ammonia, chloride, sodium and sulfate from the disposal site are reaching Butters Row Well #1 and Chestnut Street Well #1 and the Butters Row Treatment plant.

Current water quality data from Butters Row Well #1 and Chestnut Street Well #1 indicate that some inorganic analytes associated with the groundwater plume are present in those wells. The concentrations of ammonia and sulfate in particular indicate that some Site constituents have been drawn to these two wells. Sampling and analysis of finished water from the Butters Row Treatment plant indicates that analytical parameters are present at concentrations at or above background. It should be noted that chromium has not been detected in any of the five town wells in the area.

As presented in Section 5.0 of the Supplemental Phase II Investigation, transport modeling has concluded that ammonia, chloride, sodium, and sulfate might continue to be drawn to Butters Row Well #1 and Chestnut Street Well #1 in the future. Therefore, the finished water from the Butters Row Treatment Plant is also considered an exposure point for future conditions. For current and future land and groundwater uses, the following receptors are potentially exposed to finished water from the Butters Row Treatment Plant: Town residents, On-property workers, and workers at neighboring industrial commercial facilities (represented by Altron). No detectable chromium would be expected to reach any of the town wells.

In addition to potable use of groundwater, there are two non-potable exposure scenarios for groundwater under current and future land use. On-property and Off-property workers might be exposed, via inhalation, to vapors migrating from shallow groundwater into buildings. In addition, Off-property industrial workers might be exposed to OHM that are present in two wells at the Altron facility to the west of the site. The water from those wells is used as non-contact cooling water and as industrial process water, particularly for washing processed materials. Limited direct contact (dermal) worker exposure with this water is possible and if volatiles are present in this water, then release of those volatiles from the water into building air could result in worker inhalation exposure.

4.1.4.4 Surface Water

Exposure points identified for surface water under potential future land use include the surface water hot spot (historical data) and the remainder of the ditches that are not within the hot spot as shown on Figure 19. These exposure points represent realistic exposure points for future land use that involve the elimination of the perimeter fencing. In that case, neighborhood residents and site workers could have access to the entire ditch system and central pond. Under current land use, however, the perimeter fencing prevents access to On-property surface water by neighborhood residents and prevents access to Off-property surface water by site workers. Therefore, for current land use, the exposure points are identified as East Off-property surface water, On-property surface water, and West Off-property surface water, as shown on Figure 20. In addition to the historical (pre-weir) data, there are surface water quality data from 1995 (post-weir). The chromium concentrations in that data set are low, indicating there is no longer a chromium hot spot as shown on Figure 21.

Under current and future use, a neighborhood resident child playing in the ditches on and adjacent to the property could be exposed to contaminated surface water through incidental ingestion and dermal contact. On-property workers could also be exposed to surface water in the ditches and pond via incidental ingestion and dermal contact during maintenance activities.

4.1.4.5 Sediment

Exposure points identified for the sediment under potential future land use include the hot spot and the remainder of the ditches that are not within the hot spot, as shown in Figure 22. These exposure points represent realistic exposure points for future land use that involves the elimination of the perimeter fencing. Under current land use, however, the perimeter fencing prevents access to On-property sediment by neighborhood residents and prevents access to Off-property sediment by site workers. Therefore, for current land use, the sediment exposure points are identified as East Off-property, South Ditch, and West Off-property, as shown on Figure 23.

Under current and future use, a neighborhood resident child playing in the ditches on and adjacent to the property could be exposed to contaminated sediment through incidental ingestion and dermal contact. Current and future On-property workers could also be exposed to sediment in the ditches and pond via incidental ingestion and dermal contact during maintenance activities.

4.1.4.6 Air-Inhalation of Vapors

Under current and future use, workers On-property or at an adjacent industrial facility could be exposed via inhalation to volatile compounds (including ammonia) migrating from groundwater to soil gas and subsequently through foundation walls and floors into buildings. The exposure point was identified as the shallow groundwater "volatiles area" that is located On-property and slightly to the west of the property as shown in Figure 17.

An On-property utility worker (current and future use), and an On-property construction worker (future use) could be exposed to soil gas contaminants released during soil excavation via inhalation.

Under current and future land use, workers at neighboring facilities that use groundwater for process water could be exposed via inhalation to vaporized ammonia or volatile organic compounds. The wells at the Altron facility are evaluated for this exposure pathway. Other industrial properties downgradient of the site have been notified of the groundwater conditions and have been offered an opportunity for DPS that has associated with it a Groundwater Management Plan designed to prevent human and environmental receptor exposure to groundwater in the areas covered by the DPS. In addition, the Town Board of Health is required to evaluate permits for installation of new wells per the Board of Health Code of Regulations, Section 6. The Board would not approve of installation of new wells if that would endanger public health. Therefore, no other exposures associated with active use of groundwater in this GW-2/GW-3 area are evaluated.

4.2 DEVELOPMENT OF EXPOSURE PROFILES

Exposure profiles identifying potential receptors, potential exposure points, exposure medium and route, frequency of exposure, duration of the exposure event, and duration of the exposure period are summarized in Table 17 for current use and foreseeable future use. The utility worker and the construction worker could be exposed for extremely limited periods (two weeks and two months, respectively) and have been evaluated for subchronic exposures. The duration of the exposure periods for the other potential receptors is ten years or greater; these receptors have been evaluated for chronic exposures.

4.2.1 Current Use Exposure Profiles

The following exposure profiles describe potential receptors and the specific exposure parameters that were used to estimate exposure under current site use.

4.2.1.1 Neighborhood Resident

Child residents (7 through 16 years of age on Table 17) living near the Wilmington property are potentially exposed to contaminants while playing in the ditches around the Facility. Current exposures are assumed to occur in the East Ditch Off-property and West Ditch Off-property, which are outside the fenced perimeter of the Facility. Exposures to both surface water and sediment could occur via incidental ingestion of and dermal contact with each medium. The exposure frequency and duration of the exposure period for each potential exposure is assumed to be six events per year (two events/month, June through August) for ten years, respectively. The duration of the exposure events will be one day per event for surface water ingestion, sediment ingestion, and dermal contact with sediment, and two hours per event for dermal contact with surface water. The body weight of the child over the ten-year exposure duration is an average 42 kilograms (kg) (MADEP, 1995a). The surface water intake rate is 5 ml per event (assuming that exposure while wading is one-tenth of the default ingestion rate for incidental ingestion of water during a swimming event) (MADEP, 1995a), and the default sediment ingestion rate is 50 mg/day. The surface area exposed to surface water is 6578 cm^2, corresponding to the area of hands, forearms, legs, and feet. The surface area exposed to sediment is 4521 cm^2, corresponding to the area of head, hands, forearms, and lower legs (50th percentile males 7 through 16 years, MADEP, 1995a).

This same resident has a current and future site-related drinking water exposure because there is a complete exposure pathway for the Wilmington public water supply distribution system.

All exposure assumptions and the calculation of exposures are documented in the spreadsheets in Attachments 6 through 10.

4.2.1.2 On-property Worker

The following exposure parameters are based on an interview with Facility personnel on September 24, 1996 (Personal Communication, 1996).

An On-property worker could be exposed to surface soil contaminants while performing routine outdoor maintenance tasks. The worker could be exposed through ingestion of and dermal contact with the soil and inhalation of dust during grass-mowing activities. Exposure frequency is three events per year (12 hours per event at a rate of two hours per day). The duration of the exposure event is six days (2 hours a day for inhalation of dust) and the duration of the exposure period is 25 years. Three events per year, six days per event yields an exposure of 18 days per year. The On-property worker could also be exposed to surface water and sediment during replacement of hay bales that are located along the South Ditch. Exposure frequency is three events per year (four hours per event). The duration of the exposure event is one day and duration for the exposure period is 25 years. Soil and sediment ingestion rate is 50 mg/day. The assumed skin surface area exposed to soil is 5,200 cm^2, corresponding the areas of head, hands, and arms (50th percentile males; MADEP, 1995a). The assumed skin area exposed to surface water and sediment is 3,900 cm^2, corresponding to the areas of hands and arms (50th percentile males; MADEP, 1995a). The assumed adult body weight is 70 kg.

An On-property indoor worker could be exposed through the inhalation of volatile organic contaminants volatilizing from groundwater and migrating into a building. Exposure frequency is 250 days per year (five days per week for 50 weeks per year). The assumed duration of the exposure event is eight hours per day. The duration of the exposure period is 25 years. (A ventilation rate is not identified here because exposures are quantified in terms of average concentrations rather than doses.) Default body weight of 70 kg is used. All exposure assumptions and the calculation of exposures are documented in the spreadsheets in Attachments 6 through 10. The same On-property worker is assumed to drink 1 liter of water per work day from the Butters Row Treatment Plant water distribution system.

4.2.1.3 Off-property Worker

An Off-property worker could be exposed via inhalation to organic contaminants volatilizing from the Off-property groundwater plume and migrating into a building. Exposure frequency is 250 days per year (five days per week for 50 weeks per year). The duration of the exposure event is eight hours per day. The duration of the exposure period is 25 years. A body weight of 70 kg is used. (A ventilation rate is not identified here because exposures are quantified in terms of average concentrations rather than doses.) All exposure assumptions and calculations are documented in the spreadsheets in Attachments 6 through 10. For this inhalation exposure scenario, On-property and Off-property workers are presented in combination. The Off-property worker is conservatively represented in this risk assessment by a typical worker at the Altron facility. This is a conservative approach because the Altron facility is the only downgradient industrial/commercial property that has wells and uses groundwater for industrial purposes. It is assumed here that workers may also be exposed to the water used for industrial purposes and that they may ingest 1 liter/work day of water from the Butters Row Treatment Plant.

The exposures associated with the industrial use of the groundwater are fully described in Attachment 5. The only potential for exposure to this water is associated with the use of the groundwater as rinse water in a printed circuit board plating line and with treatment of the wastewater from this process. The rinse water is used in open tanks in a large, well ventilated room. There is potential for minimal dermal contact with the water and also potential for inhalation of any volatile constituents (such as ammonia) of the water that might be released from the water into the air. There is virtually no potential for ingestion of this rinse water (Personal Communication, 1997).

After the water is used in the plating process, it flows to a wastewater system. A preliminary treatment step is pH adjustment to pH 9.5. This adjustment from more acidic/neutral pH to the alkaline side would tend to liberate more ammonia from the water. However, this treatment takes place in a part of the facility where only a few employees are present. In addition, much of the ammonia that could be released at this step would likely be associated with addition of ammonia compounds as part of the plating process (Personal Communication, 1997).

4.2.1.4 Utility Worker

A utility worker who repairs or installs utilities located in the subsurface soil on site could be exposed to contaminants in the subsurface soil. Potential routes of exposure are ingestion of, and dermal contact with, the soil and inhalation of dust. The assumed exposure frequency for all routes of exposure is five days per work week. The duration of the exposure period for all routes of exposure is for two weeks. The duration of the exposure event will be one day for

ingestion of and dermal contact with surface and subsurface soil and 8 hours for inhalation of volatiles. The default soil ingestion rate is 500 mg/day (MADEP, 1995a).
Additional exposure parameters include a body weight of 70 kg and skin surface area exposed is 5200 cm^2, corresponding to the areas of head, hands, and arms (50th percentile males; MADEP, 1995a). All exposure assumptions and calculations are documented in the spreadsheets in Attachments 6 through 10.

4.2.2 Future Use Exposure Profiles

The exposure profiles presented in the current use section are virtually identical under a future use scenario for the following receptors:

- On-property Worker (full time, active industrial use)
- On-property Utility Worker
- Off-property Worker

Three additional potential receptors, an On-property construction worker, a neighborhood resident using the Wilmington public water supply, exposed to On-property surface soils, surface water, and sediments, as well as to Off-property surface water and sediments, and a full-time, long-term On-property industrial worker using the Wilmington PWS and exposed to soils, vapors migrating from groundwater into buildings, and to a lesser extent, surface water and sediment, are possible for future land use scenarios. All exposure assumptions and calculations are documented in the spreadsheets in Attachments 6 through 10.

4.2.2.1 Construction Worker

If the Olin site is utilized for industrial purposes, a construction worker could be exposed to contaminated surface and subsurface soil during excavation and subsequent work activities. In addition, the construction worker could be exposed through the inhalation of dust from the soil. The assumed exposure frequency for all exposures is five days per workweek. The assumed duration of the exposure period is eight weeks for all exposures. The default duration of the exposure event is one day for ingestion of and dermal contact with surface and subsurface soil and eight hours for inhalation of dust. Additional exposure parameter values for this receptor include a body weight of 70 kg, a soil ingestion rate of 500 mg/day (MADEP, 1995a), and exposed skin surface area of 5200 cm^2, corresponding to the area of head, hands, and arms. Spreadsheets documenting exposure assumptions and calculations appear in Attachments 6 through 10.

4.2.2.2 Neighborhood Resident

Assuming current site fencing is not maintained in the future, a child resident (7 through 16 years of age) living near the Wilmington property could be exposed to surface water and sediments On-property. Exposure assumptions are the same as for current Off-property exposure to surface water and sediments. These trespassers would also be exposed to surface soil contaminants while trespassing on the Wilmington facility. Exposures could occur via incidental ingestion of and dermal contact. The exposure frequency and duration of the exposure period will be 12 events per year (two events/month, May through October) for ten years, respectively. The body weight of the child over the ten year exposure duration is an average 42 kg (MADEP, 1995a). The soil ingestion rate is 50 mg/day. The exposed skin surface area is 4521 cm^2, corresponding to the area of head, hands, forearms, and lower legs (50th percentile males; MADEP, 1995a).

This same neighborhood resident could, in the future, be exposed to drinking water from the Wilmington Public Water Supply and Butters Row Treatment Plant distribution systems. While the resident might be exposed at the site for a ten-year period, the drinking water exposure duration would be 30 years for a residential scenario. Because there are no carcinogenic OHMPCs in finished drinking water, the noncancer Hazard Index was used to evaluate drinking water risk for the neighborhood resident. The child resident Hazard Index was used to represent the residential noncancer risk because the child value is higher than the adult value and they are not additive. All exposure assumptions and calculations are documented in the spreadsheets in Attachments 6 through 10.

4.2.2.3 On-Property Full-Time, Long-Term Industrial Workers

If in the future, the property were put again to active industrial use, a full-time, long-term industrial worker might be present. A conservative frequency of exposure to surface soil of 153 events/year (equal to the MADEP default exposure frequency for residential scenarios) has been assigned to this receptor. The wooded, low-lying area in the surface soil grid area 8 is not as accessible as other portions of the property. Therefore, exposure frequency for that area is estimated to be roughly 25% of the rest of the property, or 38 days/year. This is likely to be an overestimate of exposure. This worker might also be exposed to vapors migrating from groundwater into buildings. This worker might also drink 1 liter/day of water from the Wilmington PWS five days per week for 50 weeks per year. This worker might also be exposed infrequently to surface water and sediments in the ditches at the property. This receptor would have a 25 year exposure scenario.

4.3 IDENTIFICATION/ESTIMATION OF EXPOSURE POINT CONCENTRATIONS

Exposure Point Concentrations (EPCs) are identified for each exposure point described previously. For those locations/media where field sampling was performed, measured EPCs are calculated. To predict future concentrations (at the Wilmington Water Supply Wells), or to estimate concentrations that may currently occur but for which no sampling was performed (for example, the concentration of respirable particulates in air during excavation), modeled EPCs are estimated.

Although the MCP requires that an EPC be calculated for each exposure point, there is not a corresponding requirement to calculate risks at each exposure point in a Method 3 risk assessment. Therefore, for soils, surface water, and sediment, this assessment utilizes an "overall site EPC" for each receptor/medium combination. This "overall site EPC" is calculated via a multi-step process. The EPC is calculated at each exposure point; it is determined whether each receptor might be exposed at multiple exposure points; it is determined if each exposure point has equal access and probability of exposure; and then a surface area-weighted EPC is calculated for each OHM in each medium for each receptor.

For surface soil, there are nine separate exposure points that are shown on Figure 15. The EPCs at each of the surface soil exposure points are shown in Tables 18 through 26. There are three separate areas of the site with respect to surface soil exposure: the area with buildings, the area without buildings, and the Sulfate Landfill. All current and future land use receptors have the potential to be exposed at each of the three areas of the site. Based on interviews with plant personnel and observations of site features, it was determined that for the identified current use surface soil receptors, each of the individual exposure points is equally accessible. The frequency of exposure at each exposure point is assumed to be a function of the surface area of the exposure point relative to the remainder of the site. For the future long-term, full-time industrial worker, it is assumed that all exposure areas are equally accessible except for surface soil Grid Area 8. For surface soil, the "overall site EPC" was calculated as shown in Table 27. Based on the relative surface area represented by each exposure point, a weighted EPC was calculated for the area with buildings and for the area without buildings. Then, based on relative surface area represented by the two areas, a weighted average "overall site EPC" is calculated for each analyte. This "overall site EPC" is used as input for calculating surface soil exposures. The Sulfate Landfill surface soil was evaluated independent of the other two areas of the site because it is removed physically from the remainder of the site.

For the long-term, full-time industrial worker, it has been assumed that surface soil Grid Area 8 is not as accessible as the rest of the area without buildings. That area is heavily wooded and is wet in the low lying areas. Because it is a wetland area, it is unlikely buildings will be constructed there. Therefore, it is assumed this future industrial worker would be likely to visit this area with a frequency of roughly 38 times per year, or roughly one day per week April though December. The assumed industrial worker exposure frequency for the remainder of the site (mostly open un-wooded land) is 153 days per year. Therefore, for this receptor, the "overall site EPC" was calculated using the approach described above, but with a "weighting factor" for Grid Area 8 that reflects the relative surface area and a frequency of exposure that is approximately 25% of the frequency of exposure in the other areas of the site.

For subsurface soils, the identified receptors are future utility workers and future construction workers. Each of these receptors could be exposed with equal probability at any location within the Facility property (excluding the Sulfate Landfill for which an AUL prevents excavation of soil). The EPCs at each of the subsurface soil exposure points are shown in Tables 28 through 34. As shown in Table 35, an "overall site EPC" is calculated based on the relative surface area represented by each of the six subsurface soil exposure points shown in Figure 16. The "overall site EPCs" are used to calculate subsurface soil exposures.

This approach clearly overestimates likely exposures and risks for these receptors. All subsurface soil hot spots have been included in the calculations of the overall site EPCs for these receptors, even though the AUL for the Facility property would prevent excavation activity within any identified subsurface soil hot spots without further evaluation, under the supervision of an LSP, of the potential exposures and risks. Based on such an evaluation, worker protection measures might be required if such excavation activities were to be conducted.

For groundwater, the exposure points are located either in the non-Zone II area or in the Zone II area. Exposure points for the non-Zone II area include the shallow groundwater hot spot, the dense layer hot spot, the Altron wells, and the remainder of the non-Zone II area as shown in Figure 17. For the Zone II area, exposure points include the Plant B area hot spot, the dense layer hot spot, the Butters Row well #1, Chestnut Street well #1, the Butters Row Treatment Plant distribution system, and each monitoring well within the remainder of the Zone II area as shown in Figure 18. EPCs for Butters Row Well #1 and Chestnut Street Well #1 as well as other groundwater exposure points have been identified in this report. However, only post-treatment water quality data are used to calculate potential exposures and risks because receptors are not exposed to untreated water. The EPCs for each of the groundwater exposure points are shown in Tables 36 though 49.

Because the only realistic drinking water exposure point is the distribution system for the Butters Row Treatment Plant, EPCs for current conditions and for possible future conditions (based on plume and groundwater modeling) in the finished water from the Butters Row Treatment Plant have been used in calculating non-cancer and cancer risk estimates. For current conditions, the EPCs are based on data collected in April 1997 (Table 45). For future conditions, the EPCs are based on the results of the plume, groundwater, and chemical transport modeling activities (described in Sections 5.1 and 5.2 and Appendices P and Q of the Supplemental Phase II Report) and chemical treatment processes that are conducted at the Butters Row Treatment Plant (Tables 46 through 49).

Estimation of future finished water quality at the Butters Row Treatment Plant and identification of EPCs is best described by discussing: the conceptual understanding of the groundwater system; the approach for estimating future water quality at each of the Town wells; the scenarios evaluated; the groundwater and chemical modeling results; the treatment processes at the Butters Row Treatment Plant; and the calculation of EPCs in the finished water.

The conceptual understanding of the groundwater system is key to the modeling exercise. The major points of the conceptual understanding are:

- Movement of the dense layer of inorganic constituents from the Site to the west has been gravity driven. The dense layer historically flowed along the bedrock surface.

- The dense layer is currently moving very slowly, if at all.

- Geochemical modeling and field verification indicate there is not much mixing between the dense layer and the overlying groundwater. There is a sharp concentration gradient between the dense layer and overlying water.

- Geochemical modeling and field verification indicate that while chromium is soluble in the dense layer, the geochemistry of the system does not allow measurable chromium to be present in the overlying groundwater.

- There is a groundwater divide in the vicinity of Main Street. Groundwater to the east of Main Street flows toward the pumping Altron wells. Groundwater to the west of Main Street flows towards the Maple Meadow Brook wetland and the Town wells.

- No chromium has been detected in shallow or intermediate wells in the Maple Meadow Brook wetland or in any Town wells.

- The more soluble Site constituents (ammonia, sulfate, chloride, and sodium) have reached Butters Row Well #1 and Chestnut Street Well #1.

- Most of the groundwater drawn to Butters Row Well #1 and Chestnut Street Well #1 originates at shallow to intermediate depths in the wetlands or outside the area of contaminated groundwater.

- Groundwater from the five Town wells is mixed before entering the Butters Row Treatment Plant, from which finished drinking water is distributed.

The approach for estimating future water quality at each of the Town wells included identification of flow paths to each of the town wells (particle tracking) and modeling of groundwater and chemical transport along those flowpaths. The determination of flowpaths and associated flow volumes are described in detail in Section 4.5 of Appendix P of the Supplemental Phase II Report. The chemical transport modeling is presented in detail in Appendix Q of the Supplemental Phase II Report.

Constant density groundwater flow and particle tracking modeling using USGS codes MODFLOW and MODPATH was used to help determine potential contaminant transport in Maple Meadow Brook groundwater to the Town of Wilmington municipal supply wells under differing conditions of pumping and seasonality. The pumping wells evaluated were Butters Row well #1 and Chestnut Street well #1. Four scenarios were evaluated:

1. All five municipal wells pumping at a five year average rate during the wet season (with GW-83-D, without GW-83-D);
2. Only Butters Row well #1 pumping at capacity (1 mgd) during the wet season;
3. All five municipal wells pumping at a five-year average rate during the dry season;
4. Only Butters Row Well #1 pumping at capacity (1 mgd) during the dry season.

For each of the two wells, a number of flow "particles" were initiated at the well head and then backtracked upgradient (i.e., allowed to flow in reverse) from the well to the point of origin in the aquifer. This allowed a series of flowlines from the aquifer to each well to be defined. The volume of water contributed to each well from each particle flowline was then determined.

Each of the flowlines was examined to determine the percentage of contribution from each portion of the aquifer (background, shallow, intermediate, deep) and to determine the water quality encountered as the particle flowline passed through different portions of the aquifer. For many flowlines, water quality along the path was either from water unaffected by contamination or flowed through shallow-depth groundwater. Other flowlines passed through intermediate or deep portions of the aquifer where water quality has been degraded by site contaminants. The "worst" water quality encountered by each flowline was then determined, either by assigning it the water quality of a nearby well, or calculating a distance-weighted average if more than one well was nearby.

The water quality assigned to a flowline was then adjusted according to the percentage of water contributed to the pumping well from that flowline. For example, if a flowline passed through a portion of the aquifer having 100 mg/L sulfate, and the flowline contributed 2.5% of the total water pumped, then the contribution of sulfate from that flowline is 100 X 0.025 = 2.5 mg/L. Since the volume sum of all flowlines equals unity, the contribution of sulfate is summed for all flowlines and that is the predicted concentration of sulfate at that well for that scenario.

The scenarios evaluated are intended to bracket realistic and worst case conditions. The scenarios involving all five wells pumping are the most realistic given the Town's drinking water needs. The scenarios involving Butters Row Well #1 as the only pumping well are intended to evaluate a worst case situation (i.e., it assumes that all of the drinking water is provided by the Town well that is most impacted by the Site and there is no mixing with other wells).

The scenarios involved wet season and dry season conditions. The conditions during the dry season simulations do not represent a typical flow regime in this area. The dry season simulations may be typical of particularly dry periods that may occur several years apart and for relatively short periods of time. On the other hand, the wet season simulations are probably representative of actual conditions for several months of every year. Therefore, the dry season predictions can be considered unusual and extreme. Actual conditions over several years will fall between the wet and dry seasons, but probably closer to the wet season.

Simulations for all five wells pumping during the wet season were conducted in two ways. In one approach, flow paths for Butters Row Well #1 and Chestnut Street Well #1 include water quality representative of the deep monitoring well GW-83-D. In the other approach, the simulation does not include water quality associated with GW-83-D because the groundwater modelers believe water from that depth would probably not be captured by the Town wells.

The results of the groundwater and chemical transport modeling, and estimated concentrations of inorganic constituents and total dissolved solids at Butters Row Well #1 and Chestnut Street Well #1 are presented in Table 5-3 to the Supplemental Phase II Report. These results have also been incorporated into Tables 46 through 49 of this risk assessment as a component of the calculation of EPCs for water leaving the Butters Row Treatment Plant. The predicted future water quality (likely maximum concentrations) for these two wells is generally consistent with historical and current water quality in those wells (with the exception of the wet season scenario with all wells pumping, which includes particles from monitoring well GW-83-D). The latter scenario yields marginally higher constituent concentrations at Butters Row Well #1 and substantially higher concentrations for Chestnut Street Well #1. For this scenario, concentrations of ammonia - N, iron and sulfate are approximately ten-fold higher than the same scenario which excludes input from monitoring well GW-83-D (Table 46). The results from this scenario are considered a worst-case, unlikely scenario because the water in this deep well would probably not be captured by the Town wells.

One surprising result of the modeling is that when only Butters Row Well #1 is pumping, the water quality in that well would be better than when all five wells are pumping. This would occur because, without the other wells pumping, Butters Row Well #1 captures more water from unimpacted areas. Overall, however, the scenario with only Butters Row Well #1 pumping would still represent a worst case scenario for finished drinking water, because there is no mixing of that water with unimpacted water from Butters Row Well #2, Chestnut Street Well #2/1A, and the Town Park Well (assuming the GW-83-D scenario is not realistic).

For surface water and sediment, there is a single large hot spot that encompasses the majority of the Off-property West Ditch, On-property Ditch, and the Off-property East Ditch system (Figure 19). However, under current land use, the existing perimeter fence prevents the neighborhood residents and On-property workers from being exposed to the entire hot spot area. Therefore, for current land use, three separate points are identified (Figure 20). A separate receptor group is identified for each of these exposure points. A neighborhood resident living to the west of the facility might be exposed in the Off-property West Ditch. Neighborhood residents living to the east of the facility might be exposed in the Off-Property East Ditch. On-property workers might be exposed in the On-property South Ditch and Central Pond. No area weighting of EPCs was conducted for these current land use exposure points. It should be noted that in addition to the historical data, there is also a recent data set (post-1994) for metals in surface water. The same three current land use exposure points were applied to these recent data.

With respect to future land use, it is presumed that a perimeter fence may no longer exist. Under those conditions, each of the receptors might be exposed to the entire identified hot spot and non-hot spot areas of the ditch system. Therefore, for historical data, the two surface water exposure points (hot spot and non-hot spot) are surface area weighted to derive an "overall site EPC" for each analyte in surface water. For the 1995 surface water analytical data there is a single exposure point as shown in Figure 21. The EPCs at each of the surface water exposure points are shown in Tables 50 through 58. A similar approach is used for sediment. EPCs for sediment exposure points are shown in Tables 59 through 64.

The derivation of the "site EPCs" for surface water and sediment for future land use are shown in Tables 58 (historical data) and 64. Sediment exposure points are shown in Figure 22 and Figure 23. Weighted EPCs were not calculated for recent surface water data because there is not a hot spot for that data and there is only one exposure point for future use.

4.3.1 Measured Exposure Point Concentrations

For a given chemical in a given exposure area, EPCs for contaminants in surface soil, subsurface soil, sediment, and surface water were calculated by taking the arithmetic average of all results. Non-detects were assigned a concentration equal to one-half of the SQL. Concentrations in duplicate samples were averaged and the result treated as one data point in the calculation of the EPC. Generally, if the average concentration exceeded the maximum detected concentration, the maximum concentration was used as the EPC.

EPCs have been calculated for the shallow groundwater "volatiles" exposure point and for the Altron wells exposure point. The EPCs selected to represent potential exposures to the shallow groundwater "volatiles" exposure point under current land use conditions were based on the maximum detected concentrations from samples collected after January 1, 1995. EPCs selected to represent worst-case future conditions were based on the maximum detected concentrations in these and historical groundwater samples. The EPCs for the Altron wells were based on maximum detected concentrations from the most recent sampling event (October 17, 1996) to represent a worst case groundwater scenario. These EPCs are used as inputs to the models used to estimate exposures via vapor migration into buildings and via industrial use of groundwater in the area downgradient of the site.

Individual EPCs for each exposure point for surface soil, subsurface soil, shallow groundwater, deep groundwater, surface water, and sediment are presented in Tables 18 through 64. It should be noted that the EPCs for the "volatiles" exposure point and the Altron wells exposure point (Table 43) are used as inputs to exposure models for indoor air and industrial water use.

EPCs have been identified for untreated water at Butters Row Well #1 and #2 and Chestnut Street #1 (Table 44). EPCs have been identified for the Butters Row Treatment Plant distribution system under current conditions (Table 45). The EPCs are the reported analytical results from the April 24, 1997, sample of finished water. The sample was identified as "BRTP" and was assigned a laboratory identifier of 970923A-01. No volatile organic compounds were detected in the sample. Inorganic parameters included in the analysis of this sample include ammonia, chloride, sulfate, total dissolved solids, iron and manganese. Although there is a reported result for ammonia in that sample, the phenate extraction method used in the analysis measures combined (chloramines) as well as free ammonia. Since there is free residual chlorine in the water, un-combined ammonia could not be present in the finished water. Butters Row Treatment Plant in-house laboratory detected iron, manganese, total chlorine, free chlorine and pH. The EPCs used to calculate risks for current conditions in the Butters Row Treatment Plant distribution system are shown in Table 45.

4.3.2 Modeled Exposure Point Concentrations

For media that were not sampled or for predicting EPCs for future exposure scenarios, modeling was conducted. Brief discussions of each modeled exposure pathway are presented below and each of these pathways is addressed in more detail in Attachment 5. The modeled EPCs for these pathways are shown in the appropriate spreadsheets in Attachment 5 and in Attachments 6 through 10.

4.3.2.1 Indoor Air

Modeling was conducted to estimate indoor air concentrations as a result of volatilization from groundwater and migration through foundation walls and floors. A Gas Research Institute model (developed by Atlantic Environmental Services, 1988) for vapor intrusion was used to estimate indoor air concentrations to which workers On-property in the "office building" or Off-property workers in a building located on property immediately south of the Facility could be exposed. This model is discussed in detail in Attachment 5. The resultant indoor air EPCs for the On-property worker and the Off-property worker are presented in that attachment and in the spreadsheets in Attachment 8 and in Tables 36 and 37.

Modeling was also conducted to estimate indoor air concentrations resulting from use of groundwater as process water for industrial applications at the Altron facility adjacent to the western property boundary. Indoor air EPCs for this scenario were estimated by calculating the maximum amount of volatile OHM that could be released from process water, based on site-specific process parameters (e.g., water usage, building volume, building ventilation) obtained from interviews with Altron facility personnel (Personal Communication, 1997). Because the volatility of ammonia can vary among chemical species, the air EPC calculations for ammonia were based on worst-case estimates of the amount of ammonia that may be present in Altron wells in the volatile form (i.e., NH_3^0). Details for the Altron model, including documentation of air EPC and ammonia chemical specification calculations, are presented in Attachment 5. The resultant indoor air EPCs for the On-property worker and the Off-property worker are presented in that attachment and in the spreadsheets in Attachment 8 and in Table 43.

4.3.2.2 Fugitive Dust

Concentrations of respirable particulates in air during excavation activities (utility and construction workers) were assumed to be equal to 60 ug/m^3, and 32 ug/m^3 for non-excavation activities, per MADEP guidance (1995a).

4.3.2.3 Wilmington Town Water Supply

EPCs have been estimated for future conditions at Butters Row Well #1 and Chestnut Street Well #1 as well as at the Butters Row Treatment Plant distribution system based on the groundwater and chemical transport modeling that is presented in Appendices P and Q to the Supplemental Phase II Report and summarized in Subsections 5.2.1 and 5.2.2 of the Supplemental Phase II Report. As previously discussed, four different scenarios involving the Town wells have been modeled: all five wells pumping, wet season; all five wells pumping, dry season; only Butters Row Well #1 pumping, wet season; and only Butters Row Well #1 pumping, dry season. The scenario for all five wells pumping during the wet season was modeled two ways (including and excluding water from the deep monitoring well GW-83-D). The modeling predicted maximum concentrations at the two potentially impacted wells, Butters Row Well #1 and Chestnut Street Well #1, for each of the scenarios. The predicted concentrations (EPCs) for each of those wells are shown in Tables 46 through 49.

For each of the four future scenarios, concentrations in raw water entering the Butters Row Treatment Plant and in finished water leaving the treatment plant have been estimated. The estimated concentrations in the finished water are considered EPCs for future conditions for the Butters Row Treatment Plant distribution system. These EPCs are shown in Tables 46 through 49.

The raw water entering the treatment plant is composed of water from all five wells (two scenarios) or from only Butters Row Well #1 (two scenarios). As shown in these tables, the concentrations in the raw water entering the treatment plant are essentially flow-weighted averages of the concentrations in the five wells. The typical flows are average flows over the last five years as reported in Subsection 4.5 of Appendix P to the Supplemental Phase II Report. The concentrations for Butters Row Well #1 and Chestnut Street Well #1 are estimated concentrations from the chemical modeling as presented in Table 5-3 of the Supplemental Phase II Report. The concentrations for Butters Row Well #2, Chestnut Street Well #2/1A and Town Park are from Table Q-1, Average Composition of Groundwater Samples Collected within the Maple Meadow Brook Wetland, of Appendix Q to the Supplemental Phase II Report. The concentrations of groundwater constituents in finished water leaving the Butters Row Treatment Plant have been estimated based on the nature, efficiency, and capacity of the treatment processes that are currently in place.

The Butters Row Treatment Plant is one of two drinking water treatment plants in Wilmington. The Sargent Treatment Plant treats water from Shawsheen Avenue, Brown's Crossing, Salem Street, and Barrows Road. There are some plans to pipe the Shawsheen Avenue water to Butters Row well #1. The water distributed from Butters Row Treatment Plant serves roughly half of town and Sargent serves the other half (there is no mixing of the water from the two plants prior to distribution).

The treatment plant has a design capacity of 3 mgd and the capacity to produce 4 mgd in emergency situations. For the last five years, the average flow through the Butters Row Treatment Plant has been approximately 1.4 mgd.

The current treatment plant operation includes the following operations:

1. Aeration to remove TCE and CO_2 (incoming water pH = approximately 5.2 - 5.5)
2. Lime and alum addition (pH = approximately 5.9)
3. Potassium permanganate and polymer addition followed by flocculation and sedimentation
4. Filtration with activated carbon
5. pH adjustment with lime (pH = approximately 8.5)
6. Chlorination for disinfection (chlorine gas injected into finished water line)

Current dosing at various points in the process:

Alum 41.74 mg/L

Pre-lime 23.74 mg/L
Potassium permanganate for oxidation of iron and manganese 2.30 mg/L
Polymer (coagulant aid) 0.2 mg/L
Post lime 9.46 mg/L

Cliff Preble, Treatment Plant Operator, indicated there is approximately 1 mg/L free-residual chlorine in finished water and approximately 2 mg/L total chlorine (maximum) in the finished water. Recent monitoring data for the treatment plant support this information. Although the treatment plant was not designed specifically to do so, the disinfection process via chlorination would oxidize any ammonia present in the water at that stage, provided the chlorination is carried out to the breakpoint. Presence of free residual chlorine would indicate that the chlorination has been carried to the breakpoint.

There is a limit to the amount of ammonia that could be oxidized by the current treatment system. Two oxidation steps (permanganate and chlorine) could potentially oxidize the ammonia. Oxidation of ammonia by chlorine is well documented in basic water treatment texts. The oxidation of ammonia by permanganate is not discussed. Based on the electrical potential of the permanganate reduction half-reaction, it appears that oxidation of ammonia by permanganate is thermodynamically favored, and it is expected there is some removal during this stage of the treatment. Stripping of ammonia in the tower is unlikely at the pH indicated. Carbon does not remove significant ammonia from water. For the purposes of estimating a maximum ammonia concentration that could be handled by the treatment plant, it is assumed that permanganate is consumed by other inorganics (Fe and Mn) and that only chlorine is available to remove ammonia. The maximum capacity of the chlorination system is 12 mg/L at a flow rate of 3 mgd.

Assuming that a free residual chlorine concentration of 1 mg/L is desired, that leaves 11 mg/L of chlorine that can react with ammonia. Chlorine and ammonia react through at least three recognized reaction paths. These paths yield either nitrogen gas, nitrate ion or nitrogen trichloride gas. The initial reaction in all paths is the formation of monochloramine. This is the typical drinking water chloramination process. With the addition of excess chlorine, dichloramines and subsequently nitrogen trichloride gas, nitrate ion and nitrogen gas may be formed. The ratio of these products is a very complicated function of the ammonia/chlorine stoichiometry and pH. Ammonia and chloramines can be completely removed from water by reaction with chlorine. Typically this will require a weight ratio of 10 parts chlorine for each part ammonia. Taking these reactions into consideration, the Butters Row Water Treatment could provide satisfactory treatment of an ammonia influent concentration of ~3.5 mg/L. The treated water would contain ~1 mg/L of free available chlorine and ~3 mg/L of combined chlorine (chloramines). This water would be in compliance with the proposed USEPA Disinfection Byproduct Rule. (Currently there is no MCL for chlorine or chloramines).

Ammonia will be essentially completely removed up to the limit of the oxidizers added. There may be formation of nitrates instead of nitrogen gas to some degree. The stoichiometric removal of NH_3 by chlorine requires a molar ratio of $3Cl_2$:$2NH_3N$. Practical applications frequently see a ratio closer to $2Cl_2$:1NH3N with the difference from theory explained by some of the ammonia going to nitrates instead of nitrogen gas.

No significant removal of sulfate, chloride, and sodium is likely to be occurring based on the current treatment system. Sulfate can act as an oxidizing agent and itself be reduced to sulfide; however, it is a much weaker oxidizing agent than chlorine and permanganate and significant removal by this mechanism would not be expected. Chlorides will actually be added during the chlorination step. The chloride addition on a stoichiometric basis is equal to the chlorine dose:

$$Cl_2 + H_20 => \quad OCl^- + Cl^- + 2H^+$$

Thus, the chloride ion concentration would be increased by 12 mg/L at the maximum chlorine dose level.

The addition of alum $(Al_2(SO_4)_3$ $14.3H_20$(MW 600) will add sulfate to the water. The alum dose rate of 41.74 mg/L would increase the sulfate concentration by 20 mg/L.

In estimating finished water quality for future conditions, a treatment plant water flow of 1.3 mgd is assumed. At 1.3 mgd, a chlorine dose rate of ~27 mg/L is possible. This dose level would allow treatment of ammonia at concentrations up to ~5.5 mg/L {3 mg/L converted to chloramines and 2.5 mg/L completely oxidized to N_2, NO_3, or NCl_3} and would result in an increase in chloride ion of ~27 mg/L.

In addition to these theoretical calculations, monitoring data collected for finished water indicate efficient removal of iron (resulting in concentrations less than 0.1 mg/L) and manganese (resulting in concentrations less than approximately 0.03-0.1 mg/L). Data generated by the treatment plant's in-house laboratory indicate that incoming raw water contains approximately 2.34 mg/L to 4.48 mg/L iron and approximately 0.487 mg/L to

0.704 mg/L manganese. These data were collected during the weeks of April 20-26, 1997, and May 18-24, 1997. During those two weeks, the treatment plant laboratory reports total chlorine residual ranging from 1.84 mg/L to 3.34 mg/L (with a questionable result of 0.22 mg/L listed for April 20, 1997). During that same time period, the free chlorine was reported to range from 0.20 mg/L to 0.35 mg/L. These data are presented in the water quality summary sheets included in Attachment 5.

This technical information and the modeling predictions are not the only bases for estimating finished water quality for future conditions. The water treatment plant is required to provide drinking water that meets drinking water standards. One of those standards involves disinfection of the water. When disinfection is accomplished via chlorination, there is a requirement to have free residual chlorine in the finished water. While the presence of sulfate, chlorides, or sodium may not have a significant effect on the chlorination process, the presence of ammonia can substantially increase the chlorine demand, in some cases making it difficult or impossible to maintain a free residual chlorine concentration. In fact, at the Butters Row Treatment Plant, operators have reported the need to reduce or eliminate pumping the Butters Row Well #1 because of difficulty in maintaining free residual chlorine in the finished water. The treatment plant operators may vary pumping regimes in order to maintain free residual chlorine in the finished water.

In estimating finished water quality for future conditions, the following assumptions have been made: treatment plant water flow is approximately 1.3 mgd; sodium and chloride concentrations would not be impacted by treatment plant operations; sulfate concentrations in the finished water would be 21 mg/L higher than in the raw water due to alum treatment. Because residual free chlorine is a requirement for finished water and because residual free chlorine and ammonia cannot be present simultaneously, finished water will not contain uncombined ammonia.

It has been assumed that Total Dissolved Solids (TDS) concentrations would not be affected by treatment plant operations. Predicted future finished water quality data are shown in Tables 46 through 49. It should be noted that no detectable chromium is expected at the Town wells. In addition, iron and manganese will continue to be removed effectively, with finished water meeting the corresponding secondary MCLs. The estimated concentrations for the five wells pumping, wet season, including monitoring well GW-83-D is considered a worst-case unlikely scenario. The predicted water quality for the other scenarios is generally consistent with historical water quality in Butters Row Well #1 and Chestnut Street Well #1.

4.4 ESTIMATION OF AVERAGE DAILY DOSES (ADDS)

The average daily dose (ADD) is the amount of OHM absorbed into the body. When appropriate, it is the product of the average daily exposure multiplied by a relative absorption factor (RAF). For evaluating exposure to gaseous OHM, average concentrations of OHM in air are compared to toxicity values in units of concentration instead of calculating ADDs.

A Lifetime Average Daily Dose (LADD) is calculated in order to estimate carcinogenic risk. The Averaging Period (AP) over which the total intake of contaminant is averaged is 75 years for carcinogenic effects (MADEP, 1992).

For noncarcinogenic effects, depending on the duration of the exposure period, an Average Daily Dose, Chronic (ADD_c) for long-term exposure (seven years or longer), Average Daily Dose, Subchronic (ADD_s) for exposure periods from a month up to seven years, or Average Daily Dose, Acute (ADD_a) for exposures of one day or less may be calculated. ADD_s (other than for volatile inhalation) has been calculated for the utility worker and construction worker receptor as the exposure durations are two weeks and eight weeks respectively. ADD_c has been calculated for all other receptors (except for inhalation of volatiles).

The general form of the ADD equation is:

$$ADD = \frac{(Total\ Amount\ of\ OHM\ Intake)}{(Body\ Weight_{avg})\ (Averaging\ Period)}$$

4.4.1 Soil and Sediment Exposures

The ADD received by a receptor via direct contact with soil or sediment containing OHM (ADD_{soil}) is the sum of the ADDs for both exposure via the routes of dermal contact with the contaminated soil or sediment and ingestion of that soil or sediment. Soil- or sediment-related inhalation exposures are evaluated via average exposures rather than doses. Thus,

$$ADD_{soil} = ADD_{dermal} + ADD_{ingestion}$$

The appropriate ADD, due to dermal contact with OHM-contaminated soil (ADD_{dermal}) and due to ingestion of OHM-contaminated soil ($ADD_{ingestion}$) may be calculated as follows:

The ADD due to dermal contact with OHM-contaminated soil ($ADD_{dermal\ absorption}$) may be calculated:

$$ADD_{dermal\ absorption} = \frac{[OHM]_{soil} * SA * AF * RAF * EF * ED * EP * C}{BW * AP}$$

Where:

$ADD_{dermal\ absorption}$ =	Average daily dose of OHM received through dermal contact with soil or sediment during the period of exposure (dimensions: mass/mass·time, typical units: mg/kg·day).
$[OHM]_{soil}$ =	Representative concentration of OHM in the soil or sediment at the exposure point during the period of exposure (dimensions: mg/kg)
SA =	Skin surface area in contact with the soil or sediment on days exposed (dimensions: cm^2/day)
AF =	Mass of soil or sediment adhered to the unit surface area of skin exposed (dimensions: mg/cm^2)
RAF =	Relative Absorption Factor (unitless)
EF =	Exposure Frequency: the number of exposure events during the exposure period divided by the number of days in the exposure period (dimensions: events/day)

ED =	Exposure Duration: the typical duration of each exposure event (dimensions: time/event)
EP =	Exposure Period: the period of time over which exposure may occur (dimension: time)
BW =	Body Weight of the receptor of concern during the averaging period (dimension: kg)
AP =	Averaging Period (dimension: time)
C =	Appropriate units conversion factor(s)

The ADD due to the incidental ingestion of OHM contaminated soil ($ADD_{ingestion}$) may be calculated:

$$ADD_{ingestion} = \frac{[OHM]_{soil} * IR * RAF * EF * ED * EP * C}{BW * AP}$$

Where:

$ADD_{ingestion}$ =	Average daily dose of OHM received through the ingestion of soil or sediment, during the period of exposure (dimensions: mass/mass·time, typical units: mg/kg·day).
$[OHM]_{soil}$ =	Exposure point concentration of the OHM in soil or sediment (dimensions: mass/mass, typical units: mg/kg).
IR =	Daily soil or sediment ingestion rate on days exposed during the exposure period (dimensions: mass/time, typical units: mg/day)
RAF =	Relative Absorption Factor (dimensionless).
EF =	Number of exposure events during the exposure period divided by the number of days in the exposure period (dimensions: events/time, typical units: events/day).
ED =	Average duration of each exposure event (dimensions: time/event, typical units: day/event).
EP =	Duration of the exposure period (dimensions: time, typical units: years).
C =	Appropriate units conversion factor(s)
BW =	Body weight of the receptor of concern during the averaging period (dimensions: mass, typical units: kg).
AP =	Averaging Period (dimension: time, typical units: years).

4.4.2 Groundwater Exposures

The ADD received by a receptor via direct contact with ground water containing OHM (ADD_{gw}) is the sum of the ADDs for ingestion of the contaminated drinking water and absorption via dermal contact with the water.

$$ADD_{gw} = ADD_{dermal} + ADD_{ingestion}$$

The ADD due to ingestion of and dermal contact with OHM-contaminated drinking water (ADD_{dw}) may be calculated as follows:

$$\textit{INGESTION:} \quad ADD_{dwi} = \frac{[OHM]_{dw} \times VI \times RAF \times D_{1}\text{-}I \times D_2 \times F}{BW_{avg} \times AP}$$

$$\textit{DERMAL CONTACT:} \quad ADD_{dwd} = \frac{[OHM]_{dw} \times SA \times Kp \times CF \times D_{1}\text{-}D \times D_2 \times F}{BW_{avg} \times AP}$$

Where:

$[OHM]_{dw}$	=	Representative concentration of OHM in the drinking water at the Exposure Point during the period of exposure (dimensions: mass/volume)
VI	=	Daily volume of water ingested by the receptor of concern (dimension: volume/time)
SA	=	Skin surface area in contact with the surface water during the period of exposure. (dimension: area)
Kp	=	Permeability Constant (dimensions: volume/time x area)
RAF	=	Relative Absorption Factor (dimensionless)
F	=	Number of exposure events during the exposure period divided by the number of days in the exposure period (dimensions: events/time)
$D_{1\text{-}I}$	=	Average duration of each ingestion exposure event (dimensions: time/event)
$D_{1\text{-}D}$	=	Average duration of each dermal exposure event (dimensions: time/event)
D_2	=	Duration of the exposure period (dimension: time)
BW_{avg}	=	Average body weight of the receptor of concern during the averaging period (dimension: mass)
AP	=	Averaging Period (dimension: time)
CF	=	Appropriate units conversion factor(s)

For noncarcinogenic effects: $AP = D_2$
For carcinogenic effects: AP = 75 year lifetime

Therefore, current data modeled future drinking water scenarios for the Butters Row Treatment Plant that are described in Section 4.3 were the focus of the quantitative drinking water exposure assessment.

It should be noted that the four future scenarios were each evaluated in the exposure and risk assessment. One scenario, all five Town wells pumping during the wet season, contains two separate estimates of concentrations at Town wells and the Butters Row Treatment Plant. One estimate does not consider water quality in monitoring well GW-83-D, the other estimate does consider water quality in that well. The concentration estimate that includes GW-83-D was included to bracket future possibilities. However, the water in the deep monitoring well would probably not be captured by the Town wells. Therefore, doses and risks have been calculated for that set of circumstances, but these risks are considered unrealistic and are not included in the risk summary tables. These risks are discussed in the uncertainty analysis in Section 7.0.

For the drinking water exposure pathway at the Butters Row Treatment Plant, there are no carcinogenic OHM of potential concern for the Site. Therefore, lifetime average daily doses have not been calculated for the drinking water exposure pathway at the Butters Row Treatment Plant.

4.4.3 Surface Water Exposures

The ADD received by a receptor via direct contact with surface water containing OHM (ADD_{sw}) is the sum of the ADDs for incidental ingestion of the contaminated surface water and absorption via dermal contact with the water. Thus,

$$ADD_{sw} = ADD_{dermal} + ADD_{ingestion}$$

The ADD due to ingestion of and dermal contact with OHM-contaminated surface water (ADD_{sw}) may be calculated as follows:

$$INGESTION: \quad ADD_{swi} = \frac{[OHM]_{sw} \times VI \times RAF \times CF \times D_1 - I \times D_2 \times F}{BW_{avg} \times AP}$$

$$DERMAL\ CONTACT: \quad ADD_{swd} = \frac{[OHM]_{sw} \times SA \times Kp \times CF \times D_1\text{-}D \times D_2 \times F}{BW_{avg} \times AP}$$

Where:

$[OHM]_{sw}$	=	Representative concentration of OHM in the surface water at the Exposure Point during the period of exposure (dimensions: mass/volume)
VI	=	Daily volume of water ingested by the receptor of concern. (dimension: volume/time)
SA	=	Skin surface area in contact with the surface water during the period of exposure (dimension: area)
Kp	=	Permeability Constant (dimensions: volume/time x area)
RAF	=	Relative Absorption Factor (dimensionless)
F	=	Number of exposure events during the exposure period divided by the number of days in the exposure period (dimensions: events/time)
$D_{1\text{-}I}$	=	Average duration of each ingestion exposure event (dimensions: time/event)
$D_{1\text{-}D}$	=	Average duration of each dermal exposure event (dimensions: time/event)
D_2	=	Duration of the exposure period (dimension: time)
BW_{avg}	=	Average body weight of the receptor of concern during the averaging period (dimension: mass)
AP	=	Averaging Period (dimension: time)
C	=	Appropriate units conversion factor(s)

For noncarcinogenic effects: $AP = D_2$
For carcinogenic effects: AP = 75 year lifetime

4.4.4 Sediment Exposures

Calculation of the ADD for exposure to sediments is identical to that for surface soil (Section 4.4.1) except that normalized sediment intake or contact rates are substituted for soil intake or contact rates. The exposure assumptions used to calculate $ADD_{sediment}$ for sediment exposures are discussed in Section 4.2.

4.4.5 Inhalation Exposures

Receptors at the Wilmington site could be exposed via inhalation to contaminants adsorbed to wind-eroded particles, or volatilized from contaminated soils or groundwater to indoor or ambient air. Calculation of ADDs associated with each of these exposures are described below.

During excavation activities, construction workers could be exposed via inhalation to contaminants on wind-eroded soil particulates. For this potential exposure pathway, EPCs of contaminants on respirable size particulates have been obtained through a simple modeling procedure. Dust exposures are evaluated in the manner described below. The concentration of OHM in air associated with dust is calculated by utilizing recommended respirable particulate levels in air for various activities (MADEP, 1995a) and multiplying those levels by the concentration of OHM in soil and applying appropriate units conversion factors.

The methodology for evaluating inhalation exposures differs from that used for other exposure pathways in that the toxicity values used are reference concentrations (RfCs) and unit risks (URs) instead of reference doses (RfDs) and slope factors (SFs). Because concentration and not dose is the basis for these toxicity values, body weight (BW), respiration rate (VR), and relative absorption factors (RAFs) are not used in calculating risk estimates for carcinogenic and noncarcinogenic chemicals. Therefore, an average air concentration, rather than an ADD, is calculated.

Site workers, utility workers, and construction workers could be exposed during maintenance or excavation activities to contaminants released from soils as dust. There are no substantial concentrations of volatiles in soils that would require a quantitative evaluation of vapor release from soils. Theoretically, neighborhood residents could be exposed during showering to vapors released from contaminated groundwater. However, there is no indication that site-related volatiles are present in the Town of Wilmington Water Supply distribution system. On- and Off-property workers could be exposed to vapors that have migrated from contaminated groundwater into structures. The general equation for estimating the average air concentration due to inhalation of vapors is as follows:

$$Average\ Concentration_{air} = \frac{[OHM]_{air} \times D_1 \times D_2 \times F}{AP}$$

Where:

$[OHM]_{air}$	=	Representative concentration of gaseous OHM in the air at the Exposure Point during the period of exposure (dimensions: mass/volume)
F	=	Number of exposure events during the exposure period divided by the number of days in the exposure period (dimensions: events/time)
D_1	=	Average duration of each exposure event (dimensions: time/event)
D_2	=	Duration of the exposure period (dimension: time)
AP	=	Averaging period (dimension: time)

On-property or Off-property Worker Specific parameter values for evaluating inhalation exposures to workers from migration of vapors from groundwater into structures are:

$[OHM]_{air}$	=	Modeled air EPCs (ug/m^3) See Appendix D, Tables D-1 and D-2.
F	=	0.68 events/24 hours (250 days/365 days; USEPA, 1991)
D_1	=	8 hours/event (assumption)
D_2	=	25 years (USEPA, 1991)
AP	=	75 years - cancer (MADEP, 1992) 25 years - noncancer

4.5 ADJUSTMENTS FOR ABSORPTION EFFICIENCY

RAFs are used when calculating ADD to take into account any differences in the absorption for a particular medium and exposure pathway compared to the absorption in the study which the toxicity value is based (often a diet or gavage study using pure product in a solvent or oil carrier).

Tables A4-5 and A4-6 present the RAFs used in this assessment as well as the basis for these values.

4.6 PERMEABILITY CONSTANTS FOR DERMAL EXPOSURE TO WATER

Permeability Constants (Kp) are used in estimating contaminant exposure through dermal contact with water. A Kp is a flux value, normalized for concentration, that represents the rate at which a chemical penetrates the skin (USEPA, 1992). Use of the permeability constant in the ADD equation results in the ADD reflecting an absorbed dose rather than an intake.

Kp values for most chemicals were obtained from Tables 5-3 or 5-7 in "Dermal Exposure Assessment: Principles and Applications" (USEPA, 1992). For organic chemicals that lack published Kp, Kp values for compounds with similar structures were used as surrogates. Kp values for the remaining organics were calculated using the following regression equation (Potts and Guy, in press, via USEPA, 1992):

$$\log Kp = -2.72 + 0.71(\log Kow) - 0.0061(MW)$$

For inorganics that lack published Kp values, the Kp for water was used as a surrogate value (USEPA, 1992). The Kp values used in this assessment are presented in Table A4-7 in Attachment 4.

Once the exposure assessment is completed, the risk characterization activities are conducted as described in the following sections.

SECTION 5.0

5.0 RISK CHARACTERIZATION

In this section, potential risks to human health associated with exposure to contaminants at the Wilmington site are characterized. Risk is a function both of exposure and toxicity. The magnitude of risk depends on the nature, duration, and frequency of exposure to contaminants and characteristics of the exposed population. Information presented in the Exposure Assessment section (Section 4), combined with the dose-response toxicity data presented in the Dose-Response Assessment section (Section 3), is the basis for this risk characterization. Per the requirements of the MCP at 310 CMR 40.0993(6), risk of harm to human health is characterized by:

1. Comparing Cumulative Receptor Cancer Risk to the Cumulative Receptor Cancer Risk Limit (10^{-5}) for current and future land use; and
2. Comparing Cumulative Receptor Noncancer Risk to the Cumulative Receptor Non-cancer Risk Limit (Hazard Index of 1) for current and future land use; and
3. Comparing exposure point concentrations to applicable or suitably analogous public health standards.

5.1 CUMULATIVE RECEPTOR RISKS

The technical approach used to generate the carcinogenic and noncarcinogenic risks at this site are presented in the following subsections.

5.1.1 Cumulative Receptor Cancer Risk

For oral and dermal exposure to soil, sediment, surface water, and groundwater, carcinogenic risk estimates for known or probable human carcinogens are calculated by multiplying the cancer slope factor (CSF) of the chemical (expressed as $(mg/kg\text{-}day)^{-1}$) by the lifetime average daily dose (LADD, expressed as mg/kg-day). The product of these two values is an estimate of the excess lifetime cancer risk (ELCR), which is defined as the excess probability that an individual will develop cancer over a lifetime due to exposure to the chemical of potential concern. This incremental lifetime risk is over and above what is considered an individual's background chances of developing cancer. In the U.S., approximately one in three people develop cancer during their lifetime. (American Cancer Society, 1997)

For inhalation exposures, both air EPCs and carcinogenic toxicity values are expressed in units of concentration (EPCs - ug/m^3; Unit Risk [UR_{inh}] - $1/ug/m^3$). Since the toxicity value is based on concentration and not dose, ELCRs were directly calculated without the need to calculate LADDs. The cancer dose-response tables are presented in Tables A4-1 and A4-2 for oral and inhalation dose-response values, respectively.

The method used to estimate carcinogenic risks is based on USEPA's linearized, multistage model of carcinogenic dose-response. This model assumes that no threshold exposure level exists below which exposure to a carcinogen can be considered safe or risk-free. Therefore, any dose is assumed to result in a finite increment to an individual's lifetime risk of developing cancer.

The Cumulative Receptor Cancer Risk is calculated by estimating the cancer risk for each potentially carcinogenic OHMPC in each medium/exposure pathway associated with each receptor, first for current land use, and also for future land use. For a given receptor and land use all of the cancer risks are summed to yield the Cumulative Receptor Cancer Risk.

The ELCR for each chemical in each medium is calculated as follows:
For ingestion and dermal exposures,

$$ELCR_i = LADD_i \times CSF_i$$

or

$$ELCR_i = LAC_i \times UR_i$$

Where:

$ELCR_i$	=	Excess Lifetime Cancer Risk associated with the exposure to chemical in each exposure route for the relevant medium.
$LADD_i$	=	Lifetime Average Daily Dose of substance i in each medium received by the theoretical individual.
CSF_i	=	EPA's published cancer slope value for substance i in the appropriate medium.
LAC_i	=	The Lifetime Average Concentration of substance i in air.
UR_i	=	EPA's published carcinogenic Unit Risk for substance i in air.

The Cumulative Cancer Risk for a given medium (soil, surface water, sediment, groundwater, air) and exposure route (ingestion, dermal contact, inhalation) is the sum of the cancer risks for the OHMPCs included in that exposure route. The Cumulative Receptor Cancer Risk (CRCR) is the sum of all cancer risks for all OHMPCs in all media and exposure routes associated with that receptor for a given land use. In this assessment, risk calculation spreadsheets in

Attachments 6 through 10 document risks for each OHMPC in each medium and exposure route. Tables 65 and 66 document the current and future land use cancer risks for each receptor. These tables present total risk for each exposure route for each medium, the total risk for each medium, and the CRCR for each receptor. For this Site, because there are no site-related carcinogens in finished drinking water, cancer risks have not been calculated for this exposure pathway.

In the risk characterization, each CRCR is compared to the MCP Cumulative Receptor Cancer Risk Limit of 1×10^{-5}. Each CRCR may also be compared to the acceptable upper-bound excess lifetime cancer risk range for an individual of between 10^{-4} and 10^{-6} as specified in the National Contingency Plan (March 8, 1990, as amended).

5.1.2 Cumulative Receptor Non Cancer Risk

Noncarcinogenic effects associated with contaminant exposure include a variety of effects on various tissues and organ systems. These effects are considered to have a threshold value below which toxicant exposure results in no adverse effects.

For ingestion and dermal exposure to soil, sediment, surface water, and groundwater exposures, noncarcinogenic risk estimates are generated by comparing the average daily dose (ADD) for each contaminant to the most applicable dose-response value (Reference Dose). The non cancer dose-response values used in this risk assessment are listed in Tables A4-3 and A4-4. The ratio of the estimated body dose levels to these dose-response values is used to evaluate risk. For each individual chemical, this ratio is referred to as the hazard quotient (HQ).

To evaluate inhalation exposures average concentrations are calculated and are compared to inhalation toxicity values (RfCs), which are in units of concentration (ug/m^3).

The HQ is calculated for each chemical, via ingestion or dermal contact, as:

$$HQ = ADD_i/RfD_i$$

and for inhalation exposure,

$$HQ = AC_i/RfC_i$$

Where:

ADD_i	=	The average daily dose of substance i via the particular exposure route
RfD_i	=	The allowable daily dose for exposure to substance.
AC_i	=	The average concentration of substance i in air
RfC_i	=	The Reference Concentration for substance i in air

For a mixture of chemicals, a screening hazard index (HI) is estimated by summing the individual HQs for all OHMPCs in the media and routes of exposure. This approach assumes that multiple subthreshold exposures may result in adverse effects even if no single chemical exceeds its reference level.

Because of the assumption of dose additivity, the use of the HI is most appropriate if chemicals in the mixture are expected to exert similar toxic effects by the same mechanism. Therefore, summing the HQs of a mixture of compounds that are not expected to induce the same effects could overestimate the total risk. Therefore, if the screening HI is greater than 1, the OHMPC should be divided into groups based on the toxic endpoint or target organ on which the toxicity value (usually RfD) is based. Separate HIs would then be calculated for each group of OHMPC and those HIs would be compared to the Cumulative Receptor Non-cancer Risk Limit.

The following sections describe the risk estimates calculated for the various exposure scenarios under current land use and potential future land use conditions.

The HQs and HI values are documented in spreadsheets in Attachments 6 through 10 and are summarized in Table 65 and Table 66. Tables 65 and 66 present the highest HI values among the four realistic future drinking water exposure scenarios.

5.1.3 Comparison of Exposure Point Concentrations to Applicable and Suitably Analogous Standards

The Massachusetts Maximum Contaminant Levels (MMCLs) as promulgated in the Massachusetts Drinking Water Standards (310 CMR 22.00) (MADEP, 1996e) are applicable standards at the Town of Wilmington water supply wells and distribution system and within areas of the site where groundwater is characterized as class GW-1. The MCP requires that EPCs be compared to these standards. Under current land use, the drinking water exposure pathway with the Butters Row Treatment Plant distribution system is a realistic exposure point where MMCLs apply. With transport modeling completed, predicted future EPCs are available for the Butters Row well #1, the Chestnut Street well #1 and the Butters Row Treatment Plant distribution system where MMCLs apply. Future EPCs of OHMPCs within the GW-1 areas are also compared to these standards per the requirements of the MCP at 310 CMR 40.0993(3)(a). Each monitoring well and drinking water well in a GW-1 area is considered a separate exposure point, but realistically, only the Butters Row Treatment Plant distribution system is a true exposure point.

Massachusetts Surface Water Quality Standards are also potentially applicable. However, the human health component of the surface water quality standards involves two components, ingestion of water as drinking water and consumption of fish taken from the surface water. Neither of those exposure scenarios are applicable to these mostly man-made drainage ditches in this heavily industrialized area. Therefore, the human health components of the surface water quality standards are not considered applicable here.

5.2 RISK CHARACTERIZATION RESULTS

In the following sections, CRCR, Cumulative Receptor Non-Cancer Risk, and comparison of EPCs to applicable or suitably analogous standards are presented.

5.2.1 Cumulative Receptor Cancer Risk and Non Cancer Risk

Tables 65 and 66 summarize Cumulative Receptor Cancer and Non-Cancer Risks for current land use and future land use, respectively.

5.2.1.1 Current Land Use

Risks are calculated for the following potentially exposed receptors groups for current land use.

- Neighborhood resident east of site - exposure to surface water and sediments of the Off-property East Ditch, and treated water from the Butters Row Treatment Plant.
- Neighborhood resident west of site - exposure to surface water and sediments of the Off-property West Ditch, and treated water from the Butters Row Treatment Plant.
- Site worker - exposure to site surface soils, surface water and sediment in on-site ditches, vapors that might migrate into buildings from groundwater, and treated water from the Butters Row Treatment Plant.

- Utility worker - exposure to site surface soils and subsurface soils (including dust inhalation)
- Off-property worker - exposure to organic vapors that may migrate into structures adjacent to the site, exposure to inorganics and organics in groundwater used for industrial purposes, and exposure to treated water from the Butters Row Treatment Plant.

A summary of the risks for these receptors for current land use is presented in Table 65. For all receptors under current land use, Cumulative Receptor Cancer Risks and Cumulative Non-cancer Risks are below the corresponding MCP limits and are within the USEPA's National Contingency Plan acceptable range. Total receptor cancer risks range from $4x10^{-9}$ (Utility worker) to $2x10^{-6}$ (On-property worker). Non-cancer risks range from a HI of 0.04 (Utility worker) to 0.9 (Off-property worker).

5.2.1.2 Potential Future Use

Table 66 presents a summary of risks for the following receptor groups that may be exposed in the future:

- Neighborhood resident - exposure to drinking water from the Butters Row Treatment Plant, On-property surface soils, On-property and Off-property surface water and sediments.
- On- property Construction worker - exposure to site surface and subsurface soils. (Including dust inhalation)
- Utility worker - exposure to site surface and subsurface soils. (Including dust inhalation)
- On-property full-time, long-term industrial worker - exposure to surface soil, surface water and sediment in On-property ditches, vapors that might migrate into buildings from groundwater, and workplace ingestion of water from the Butters Row Treatment Plant.
- Off-property worker - exposure to organic vapors that may migrate into structures adjacent to the site and to inorganics and organics in groundwater used for industrial purposes as well as workplace ingestion of water from the Butters Row Treatment Plant.

A summary of the risks to these receptors for future land use is presented in Table 66. For all receptors, CRCRs and Cumulative Receptor Non-cancer Risks are equal to or below the corresponding MCP limits and are within the USEPA's National Contingency Plan acceptable range. For the On-property full-time worker, the cumulative receptor cancer risk is $1x10^{-5}$, which meets, but does not exceed, the MCP cancer risk limit. Cancer risks for other receptors evaluated range from $4x10^{-9}$ (Utility worker) to $1x10^{-6}$ (Neighborhood resident). Non-cancer risks range from an HI of 0.04 (Utility worker) to 1 (Off-property worker).

5.2.2 Comparison to Applicable or Suitably Analogous Public Health Standards

Potentially applicable or suitably analogous public health standards are available for many of the chemicals evaluated for drinking water exposures (groundwater) at the Wilmington site. These are Massachusetts Drinking Water Standards (MMCLs) promulgated under 310 CMR 22.00. No applicable public health standards published by MADEP exist for any of the chemicals in the other media where exposures could occur (soil, surface water, sediment, air).

For groundwater categorized as GW-1 per MCP criteria, drinking water standards (MMCLs) are applicable standards per 310 CMR 40.0993(3)(2) (MADEP, 1996e). MMCLs also apply to water that is delivered to any user of a public water system. The areas within the boundaries of the site that are classified as GW-1 are shown on Figure 14. Several constituents in groundwater within those areas have been detected at concentrations above corresponding MMCLs.

Each water supply well and monitoring well within the boundaries of the site are considered separate exposure points. Rather than make a well-by-well comparison of EPCs to drinking water standards, a streamlined approach is used here. All private water supply wells (there are none) and monitoring wells within the Zone II area and site boundary are identified. The maximum concentration of each detected groundwater OHMPC for the GW-1 areas is identified and compared to the MMCL. It should be noted that the private residences on Cook Avenue and Border Avenue are not within the boundaries of the disposal site, and the GW-1 area around each of the private wells (500-foot radius) does not intersect the disposal site. Therefore, as seen in Figure 14, the GW-1 areas within the disposal site boundaries are the areas west of the Facility within the Zone II of the Wilmington water supply and the portion of the facility adjacent to Eames Street, including the area of Plant B. The maximum OHMPC concentrations are identified and compared to MMCLs in Table 67 and Table 68 for the Zone II area and the portion of the Facility adjacent to Eames Street.

Within the Zone II area, the following OHMPCs have maximum concentrations (exposure point concentrations) that exceed drinking water standards: 1,2-dichloroethane; 1,2-

dichloroethene; benzene; chloroform; methylene chloride, trichloroethene, vinyl chloride, arsenic, chromium, lead, nitrate, and bis (2-ethylhexyl) phthalate. The available data indicate that 1,2-dichloroethane, 1,2-dichloroethene, vinyl chloride, arsenic, and lead in groundwater within the Zone II may not be site-related.

A comparison of estimated future concentrations in raw water entering the Butters Row Treatment Plant and finished water leaving the treatment plant to MMCLs is presented in Table 69 through 72. No primary MCLs would be exceeded in the finished water. (There are no primary MCLs for the analytes expected to reach the treatment plant.) The water entering the treatment plant does not represent an exposure point.

Because there are EPCs within the Zone II of the PWS that exceed the applicable public health standards, a condition of no significant risk of harm to health does not exist.

Within the GW-1 area located in the northern portion of the facility adjacent to Eames Street, the following OHMPC has a maximum concentration EPC that exceeds drinking water standards: bis(2-ethylhexyl)phthalate.

While there is an exceedance of the drinking water standard in the Zone II and GW-1 area, it is unlikely that any human exposure to this groundwater will occur in the foreseeable future. In addition, an ongoing groundwater interceptor system will remain in place until drinking water standards are achieved.

SECTION 6.0

6.0 CHARACTERIZATION OF RISK OF HARM TO SAFETY AND PUBLIC WELFARE

According to 310 CMR 40.0994, a Method 3 public welfare risk characterization shall consist of two major components:

1. A consideration of such factors as the existence of nuisance conditions, loss of property value, the unilateral restriction of the use of another person's property, and any monetary or non-pecuniary costs not otherwise considered in the characterization of risk of harm to health, safety, and the environment but which may accrue due to the degradation of public or private resources directly attributable to the release of the oil and/or hazardous material, and

2. Comparison of the concentrations of oil and/or hazardous material to the Upper Concentration Limits (UCLs) in soil and groundwater as described in 310 CMR 40.0996.

As documented in the Phase II report, there is currently no threat of explosion or direct contact with releases from this site that is likely to endanger public safety or welfare. A previous imminent hazard evaluation was conducted as part of an Immediate Response Action (IRA) focused on Drum Area A and Drum Area B (ABB-ES, 1996b). These areas are currently fenced and no access to these areas is currently allowed. Although some materials identified in the subsurface were identified as possible fire/explosion hazards, these materials have been in place in the subsurface for more than 20 years without any such hazardous conditions being observed. Under current site conditions, no nuisance conditions are known to exist. Access to the Site is restricted and no noxious fumes or noises are associated with the Site. A condition of no significant risk of harm to safety exists at the Site for current land use conditions. Under future land use conditions, potential fire/explosion hazards may exist if the Drum Area A and Drum Area B areas are excavated. A condition of no significant risk to harm or safety does not exist for future land use conditions.

Although Limitations With Respect To Groundwater have been implemented on properties along Main Street, these limitations have not been applied unilaterally. The owners of these properties have been compensated for the limitations on groundwater use. In a like manner, the Groundwater Management Plans that are part of the DPS for the neighboring industrial properties are not applied unilaterally and they benefit those property owners because their responsibility to investigate or remediate the groundwater is eliminated by maintaining the DPS status.

The existence of OHM within the Zone II of the Town of Wilmington PWS may represent a loss of available public resources because it limits future available groundwater resources for the Town. A recent report indicates that the Town of Wilmington has identified the need to develop an additional 1.8 million gallons per day drinking water capacity over the next several years. The presence of the dense layer may prevent the development of additional water supply wells in the Maple Meadow Brook area. Further study will be required to determine if that area would have been a realistic drinking water resource in the absence of the dense layer. If it is confirmed that the presence of the dense layer has resulted in reduction in public groundwater/drinking water resources, a condition of no significant risk of harm to public welfare would not exist for future land use.

There is evidence that due to potential future loadings of ammonia to Butters Row Treatment Plant, manipulations and/or modifications of Butters Row Treatment Plant operations may be required to maintain adequate chlorine residuals to insure disinfection of treated water. Increased ammonia concentrations would result in additional chlorine demand that might not be met by available chlorination capacity. Modifications to pumping regimes or treatment processes might be necessary in the future.

Massachusetts Secondary Maximum Contaminant Levels (SMCLs) are designed to protect aesthetic characteristics of water resources (such as taste and odor issues) and therefore could be considered applicable or suitably analogous public welfare standards for the groundwater beneath this site. SMCLs are not legally enforceable standards. A Zone II is the area of an aquifer that contributes to a public water supply well under the most severe recharge and pumping conditions that can be realistically anticipated.

Groundwater EPCs from monitoring wells and water supply wells were compared to SMCLs. These comparisons are presented in Tables 67 and 68. The following presents a summary of the contaminants and locations where standards were exceeded. Concentrations of aluminum, chloride, iron, manganese, sulfate, and zinc within the Zone II of the Wilmington Public Water Supply exceed SMCLs.

Tables 73 through 81, Tables 82 through 88, Tables 67, 68, 89, 90, and 91, and Tables 69 through 72 compare exposure point concentrations of OHMPCs with UCLs for surface soil, subsurface soil, groundwater and Butters Row Treatment Plant finished water, respectively. The EPCs for each hot spot and the EPCs for other exposure points are compared to the corresponding UCLs. For soils and for groundwater not in an area of GW-1 groundwater, the EPC is the arithmetic mean (or the maximum detected concentration if it is lower than the calculated mean). For groundwater within areas of GW-1 groundwater, the maximum detected concentration is the EPC, since each monitoring well or supply well is considered a separate exposure point. Rather than compare concentrations in each individual well to UCLs, the maximum concentration from all wells is compared to the UCL as a streamlining measure. If EPCs exceed UCLs, then a condition of no significant risk to public welfare does not exist.

As seen in the UCL comparison tables, there were no EPCs in surface soil or subsurface soil that exceed corresponding UCLs. The groundwater UCLs for chromium, nickel and cadmium are exceeded at the dense layer hot spot in the non-Zone II area. There are also exceedances of indeno(1,2,3-cd)pyrene, bis(2-ethylhexyl)phthalate UCLs in Plant B hot spot, and zinc UCL in Zone II groundwater.

As reported in Section 4.2.1.2, a layer of floating oil is present around the interceptor wells located at the former tank farm at Plant B. On January 26, 1997, the oil thickness was measured to be between 5 and 6 feet in the vicinity of interceptor well IW-11. Per 310 CMR 40.0996(4), the presence of non-aqueous phase liquids (NAPL) having a thickness equal to or greater than one-half inch shall be considered a level which exceeds Upper Concentration limits. Therefore, conditions in the area of interceptor well IW-11 exceed an Upper Concentration Limit.

Because there are groundwater EPCs that exceed corresponding UCLs, there is not a condition of no significant risk of harm to public welfare.

SECTION 7.0

7.0 UNCERTAINTY ANALYSIS

It should be emphasized that the risks estimated here are based on numerous assumptions. Each of these assumptions is associated with some uncertainty. Several types of uncertainties should be considered in any risk evaluation:

- uncertainties associated with estimating the frequency, duration, and magnitude of exposure
- uncertainties associated with assigning exposure parameters to a heterogeneous population that includes both men and women and young and old (e.g., body weight and ventilation rates)
- uncertainties in estimating carcinogenic slope factors and/or noncarcinogenic measures of toxicity (e.g., RfDs or RfCs)
- uncertainties about possible synergistic or antagonistic chemical interactions of a chemical mixture

The general approach to addressing many of these uncertainties is to use upper-bound (90th or 95th percentile) estimates of input values, such as exposure parameters and toxicity values. When considered together, the total receptor risk reflects an estimate that is greater than the 99th percentile. Thus it is probable that the risks presented in this document are upper-bound estimates of actual risks.

The uncertainties associated with estimating exposure result from the variance in sampling and analytical techniques, and quantifying parameters that are not directly observed (e.g., frequency and duration of exposure). Because some of these parameters are functions of the behavior patterns and personal habits of the exposed populations, no single value can be assumed to be representative of all possible exposure conditions. However, we have incorporated assumptions or procedures in the risk assessment that are conservative and should result in an overestimate of risk.

There are uncertainties in the four areas of risk assessment: hazard identification, toxicity assessment, exposure assessment, and risk characterization. Uncertainties for each of these areas are discussed below. Major uncertainties are summarized in Table 92.

Hazard Identification. There is some uncertainty associated with the lack of analytical data for Opex™ and Kempore™ in soils. However, an analytical method was developed by Olin in order to determine if groundwater in the drum areas may have been impacted by either compound. The analytical results, presented in an Immediate Response Action

(IRA) status report (ABB-ES, 1996b), indicate only one detection of Kempore™ of 3.8 mg/L in groundwater (well GW-35D) adjacent to Drum Area A. This concentration is below a risk-based drinking water concentration developed by ABB-ES (presented in Attachment 4). The presence of the compound in groundwater does suggest that Kempore™ may be present in soil or waste material within Drum Area A; however, access to this area is limited by fencing and posted signs. Therefore, exposure is limited and the degree to which risks may be underestimated is likely to be minimal.

Toxicity Assessment. The use of toxicity measures (e.g., RfDs and slope factors) introduces additional uncertainties. Slope factors are generally based on animal studies, many of which use high doses relative to the site-specific exposures actually experienced. These data require interpretation and/or extrapolation in the low-dose area of the dose-response curve. The slope factors used in the risk assessment generally represent 95th percent upper confidence limits of mean values measured in animal trials. Use of these factors may result in an overestimate of risk.

Speciation of metals can have a significant impact on the nature and likelihood of toxicity associated with exposure. Chromium is an example of such a situation. Chromium exists in the trivalent (Chromium III) and the hexavalent (Chromium VI) forms. Most of the chromium analyses conducted at this site were for "total chromium". There is uncertainty introduced into the risk estimates when speciation is not determined. In this assessment, when chromium speciation was not reported, it was assumed that 10 percent of total chromium is chromium VI. Chromium VI is the more toxic form of chromium and is a carcinogen via the inhalation route. Concentrations of both chromium VI and total chromium were reported for one surface soil sample, seven surface water samples, and seven sediment samples. Levels of chromium VI were less than 10 percent of total chromium in these samples. It appears the assumption used here is neutral to the risk estimates.

Only benzo(a)pyrene has a published oral cancer slope factor. MADEP's Office of Research and Standards (MADEP, 1995a) has published Relative Potency Factors (RPFs) to be applied to those carcinogenic PAHs without published SFs. The RPFs suggest that each of the carcinogenic PAHs other than dibenz(a,h)anthracene is at least 10 times less potent than benzo(a)pyrene, generally considered the most potent carcinogenic PAH. The application of the RPFs is a realistic means of evaluating the risk associated with the carcinogenic PAHs.

The oral Reference Doses (RfDs) for 2,4,4-trimethyl-1-pentene and 2,4,4-trimethyl-2-pentene were derived by ABB-ES (Attachment 4) because there were no published RfDs available. ABB-ES derived the RfDs from acute and subacute toxicity test results obtained from Texas Petrochemicals, Dow Chemical, and Dupont. The RfDs for the two compounds are based on the results of a two-week rat study in which slight variations in nuclei of liver cells was observed in one rat. While it is preferable to use studies of longer duration for the development of RfDs, the available data did not provide that opportunity. Therefore, there is a measure of uncertainty in the RfDs utilized for these two compounds.

Two chemical products that historically were present at the Facility were Opex™ (Dinitrosopentamethylenetetramine) and Kempore™ (Azodicarbonamide). These compounds do not have published RfDs. ABB-ES derived RfDs for these compounds (Attachment 4). Complete literature searches were conducted to obtain all available toxicity information for those compounds. In addition, the results of private toxicity studies conducted for Olin were also obtained. The RfD for Kempore™ was derived from a subchronic NOAEL from a dietary study in rats. The RfD for Opex™ was derived from a chronic NOAEL from a gavage study in rats. The selection of critical study, critical effect, and the application of uncertainty factors in deriving the RfD were consistent with USEPA protocols for developing RfDs from literature-based toxicity studies.

Exposure Assessment. There is also uncertainty associated with assigning quantitative values to exposure parameters such as body weight, ventilation rate, and absorption factors. The parameters used in this exposure assessment were based on actual or extrapolated values from surveys reported in the literature and professional judgment; therefore, they may not be representative of specific individuals at this area. However, the parameters are either mean or upper-bound (90th percentile) values and are considered representative of the populations described in the exposure pathways and are those specified by the MADEP or the USEPA to be used in risk assessments. Use of these parameters may overestimate risk, but is unlikely to underestimate it.

This assessment did not evaluate risks associated with a theoretical exposure pathway: future use of groundwater for potable use (private wells) by residents living to the west of the site. This pathway was not evaluated because all private wells within the disposal site boundaries have been or will soon be abandoned and the properties are connected to the public water supply. All residents have been provided copies of draft Notices and LSP Opinions and have been provided the opportunity to participate in the program, with, compensation. Notices of Limitation With Respect to Groundwater have also been filed for several of these properties and Olin is currently negotiating the schedule for abandonment of the sole remaining private well within the boundaries of the disposal site. In addition, no private well can be installed without the approval of the Wilmington Board of Health. Since the Board of Health is aware of the groundwater issues, the Board would not likely approve of installation of a private well in that area in the future. It is reasonably certain that there will not be any human exposure to groundwater associated with private wells at properties west of the Facility in the future. Therefore, the risk characterization with respect to this exposure pathway is realistic.

With respect to use of groundwater by industrial and/or commercial property owners to the west of the facility, the risk assessment evaluates current industrial water quality in the context of ongoing industrial, non-potable use at the Altron facility to represent both current and future exposures to groundwater constituents associated with use of groundwater in the industrial area to the west of the Facility. It is not anticipated that any additional groundwater wells will be installed in this industrial area in the future. There are a number of reasons for this conclusion. Currently, Altron is the only facility that has any active wells that are used for non-potable purposes; each of the properties in this area is connected to the public water supply; Olin has notified all downgradient property owners of the groundwater contamination; Downgradient Property Status will be achieved at most, if not all of the downgradient industrial/commercial properties; any Downgradient Property Status will have associated with it a Groundwater Management Plan; and installation of wells requires prior approval by the Wilmington Board of Health.

The groundwater transport modeling that was conducted to predict future water quality at the Town of Wilmington Water Supply Wells is another source of uncertainty. The modeling is presented in Section 5.2.2 of the Supplemental Phase II Investigation. The model evaluates potential transport of ammonia, chloride, sodium, and sulfate from medium- and shallow-depth monitoring wells that are considered potential source wells (GW-83-S, GW-83-M, GW-84-M and GW-85-M). The model simulated transport of the inorganic solutes from these source wells to Butters Row Well #1 and Chestnut Street Well #1. Transport of chromium from the source wells to Butters Row Well #1 and Chestnut Street Well #1 was not evaluated quantitatively because the model assumes that there is very little mixing of deep groundwater (containing chromium) and the shallow groundwater (chromium not detected in shallow source wells). This assumption is based on the lack of significant head differences between shallow and deep wells, which is an indication of no upward hydraulic gradients. Section 5.2.2 of the Supplemental Phase II Report concludes that "transport modeling of solutes from deep groundwater to shallow groundwater is not applicable." This model also assumes that the dense plume layer is static and will not, in the future, move in the direction of either Butters Row Well #1 or Chestnut Street Well #1.

Fate and transport models were utilized to estimate EPCs for several exposure pathways. Use of such models contributes to the uncertainty of this assessment. Because of modeling uncertainties, conservative assumptions are generally used to provide upper-bound risk estimates. Use of these fate and transport models may therefore result in an overestimation of risk, but are unlikely to result in an underestimation.

The exposure assessment for workers at the Altron facility to the west of the Facility has been conducted in a manner that likely overestimates risks for those workers. The exposure assessment assumes that the ammonia contained in the groundwater that is used as rinse water in the plating lines achieves equilibrium with the building air. However, because the Altron building is vented, the ammonia in the water would not achieve equilibrium with the air; air concentrations would remain lower than those estimated.

In addition, the ammonia concentration in the rinse water, as used in the exposure model, is an upper-bound estimate of the concentration of volatile ammonia (NH_3^0). The concentration of this ammonia species was used in this exposure model because other ammonia species (e.g., NH_4^+) are not volatile and, although present in the process rinsate water, would not volatilize to the indoor air. The ratio of ammonium ion concentration to ammonia concentration is dependent on the pH of the water; higher pH values favor the ammonia species, and lower pH values favor the ammonium ion species. Volatile ammonia concentrations were calculated as a function of groundwater pH using the USEPA thermodynamic model MINTEQA2 (see Attachment 5 for details). Groundwater volatile ammonia concentrations were calculated for three different groundwater pH values (representing the pH measured in the most recently collected groundwater samples, the arithmetic mean pH concentration in all shallow groundwater samples, and the 95% upper confidence limit (UCL) on the arithmetic mean pH values) and two different groundwater ammonia concentrations (measured in the two Altron wells). For all simulations, the volatile ammonia concentration was calculated as less than 1% of the total ammonia concentration. To provide a conservative assessment of potential current and future exposures to workers, the volatile ammonia concentration calculated for worst-case conditions (95% UCL pH [7.1], maximum detected ammonia concentration [61 mg/L]) was used as the groundwater EPC from which air concentrations were calculated. The resulting air EPC (0.33 mg/m^3) does not pose a non-cancer risk above an HI of 1 (HI = 0.8), and is well below the Workplace Air Standard of 17 mg/m^3 (ACGIH, 1995a; 1995b).

As discussed previously, the amount of volatile ammonia that may be present in groundwater is a function of groundwater pH. The volatile ammonia groundwater EPC is based on a groundwater pH value of 7.1, and this value represents an upper-bound estimate of the pH of groundwater potentially entering the Altron facility. As discussed in

Attachment 5, one of the activities involved in Altron's treatment of process wastewater involves adjusting the wastewater pH upwards to 9.5 in three tiered tanks, prior to the wastewater entering an ion-exchange or microfilter wastewater treatment process. This pH adjustment could potentially cause a conversion of ammonia ion (NH_4^+) to volatile ammonia (NH_3^0), which could then be released to the air. However, the wastewater treatment process occurs after the groundwater is used in the process line, and the wastewater treatment process occurs in a separate, unstaffed room at the Altron facility. Therefore, although volatile ammonia could be released during wastewater treatment, potential exposures would be infrequent and of short duration.

The risk assessment has concluded that, although ammonia, sulfate, chloride, and sodium reach the Butters Row Well #1 and the Chestnut Street Well #1, consumers of the water distributed by the Butters Row Treatment Plant would not be exposed to elevated levels of these analytes. The treatment plant currently treats, and for the foreseeable future, will be treating the raw water via aeration, oxidation, flocculation, settling, filtration, and chlorination. This treatment is conducted to address a chlorinated VOC issue not related to the Olin Facility (aeration, filtration with organic carbon), a naturally occurring iron and manganese problem (potassium permanganate oxidation, flocculation, settling) and for disinfection as required by federal law (chlorination). This treatment will continue indefinitely, and the treatment for iron and manganese and the chlorination for disinfection purposes will likely continue for the life of the treatment plant.

The chlorination process would eliminate ammonia from the water. In fact, chlorination is often used to eliminate ammonia from industrial wastewaters (Weber, 1972). In this process, ammonia is converted to chloramines and ultimately to nitrogen gas. The Butters Row Water Treatment Plant operator reports that the maximum total chlorine content of the finished water is approximately 2 mg/L and there is always a free-residual chlorine concentration of approximately 1 mg/L. Since chlorine would react with ammonia, the presence of free chlorine indicates that no ammonia would likely be present in the finished water (Weber, 1972).

In estimating, based on transport modeling and Butters Row Treatment Plant processes, the quality of finished drinking water, it has been assumed the treatment plant has no net effect on concentrations of chloride, sodium and total dissolved solids. However, any increased chlorine dose that might be needed to address increased ammonia concentrations, could result in an increase in chloride ion concentrations. Additional chlorine addition could lower pH requiring additional caustic to raise pH. As a result, sodium concentration might increase by as much as 18 mg/L. The total dissolved solids might increase by 40 mg/L to 50 mg/L as a result of treatment plant operations under increased ammonia loading.

Risk Characterization. To assess the overall effects of multiple chemical exposures, USEPA developed "Guidelines for the Health Risk Assessment of Chemical Mixtures" (USEPA, 1986). This guidance states that if sufficient data are not available on the effects of the chemical mixture of concern, or a reasonably similar mixture, the proposed approach is to assume additivity of effects of the constituents of the mixture. This assumption, according to USEPA, is expected to yield generally neutral risk estimates (i.e., neither conservative nor lenient). More recent guidance from USEPA (USEPA, 1989) also references the "Guidelines for the Health Risk Assessment of Chemical Mixtures", but further states that the assumption of additivity assumes independence of action and that if this assumption is incorrect, over- or underestimation of the actual multiple substance risk may occur. If OHM that have dissimilar mechanisms are evaluated, the assumption of additivity of effects may actually overestimate risk.

While it has been concluded that future excavation activities may be associated with a risk of harm to safety associated with potential fire/explosion hazards during future excavation activities associated with the possible presence of Opex™ and Kempore™, it is unlikely that fire/explosion would occur. While the Material Safety Data Sheets for these compounds indicate that they may explode or ignite, there have been no explosion or fire incidents at least since Olin purchased the Facility in 1980, nor did any incidents occur during the test pitting activities conducted in Drum Areas A and B.

SECTION 8.0

8.0 CONCLUSIONS

The assessment of risk of harm to human health indicates that for current land use and current site conditions, cancer and noncancer risks for the site worker, utility worker, off-property industrial worker, and neighborhood resident are below the corresponding MCP Cumulative Receptor Cancer Risk Limit (1 x 10^{-5}) and Cumulative Receptor NonCancer Risk Limit (hazard index = 1).

For future land use and future site conditions, cancer and noncancer risks for the On-property worker, long-term full-time On-property worker, Off-property worker, utility worker, construction worker, and neighborhood resident do not exceed the corresponding MCP Cumulative Receptor Risk Limit and Cumulative Receptor Cancer and NonCancer Risk Limit.

For groundwater within the Zone II of the Town of Wilmington PWS (classified as GW-1 groundwater per the MCP), Massachusetts MCLs (MMCLs) are considered applicable public health standards. Each monitoring well within the Zone II constitutes a separate exposure point, at which the exposure point concentration (maximum detected concentration) is compared to the MMCL. Within the Zone II area, the following OHMPCs have maximum concentrations (exposure point concentrations) that exceed drinking water standards: 1,2-dichloroethane; 1,2-dichloroethene; benzene; chloroform; methylene chloride, trichloroethene, vinyl chloride, arsenic, chromium, lead, nitrate, and bis (2-ethylhexyl) phthalate. The available data indicate that 1,2-dichloroethane, 1,2-dichloroethene, vinyl chloride, arsenic, and lead in groundwater within the Zone II may not be site-related.

Although cumulative receptor cancer and non-cancer risks are below the applicable MCP risk criteria, because groundwater exposure point concentrations within the Zone II of the PWS exceed MMCLs, which are applicable public health standards, a condition of no significant risk of harm to health does not exist.

Because of potential danger of fire or explosion associated with future excavation in the drum areas, a condition of no significant risk of harm to safety does not exist.

The risk of harm to welfare was evaluated by comparing site concentrations to Upper Concentration Limits. Because the exposure point concentrations for chromium, nickel, and cadmium in the non-Zone II dense layer hot spot, indeno(1,2,3-cd)pyrene and bis(2-ethylhexyl)phthalate in the Plant B groundwater hot spot, and zinc in Zone II groundwater are above the Upper Concentration Limits and because a public groundwater resource has been impacted, a condition of no significant risk of harm to public welfare does not exist.

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FIGURES

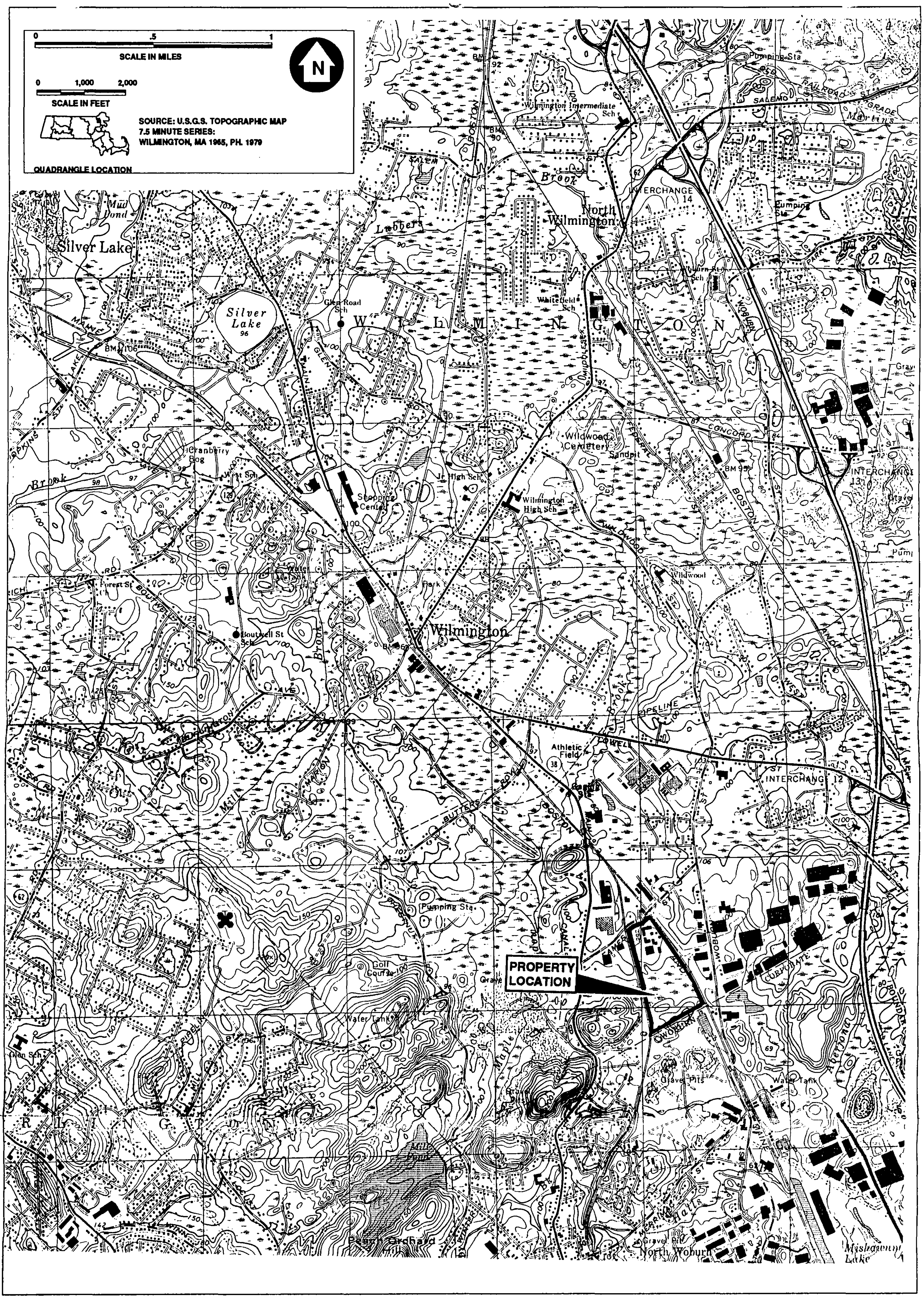

ABB Environmental Services, Inc.

FIGURE 1
PROPERTY LOCATION MAP
OLIN CORPORATION
WILMINGTON, MASSACHUSETTS

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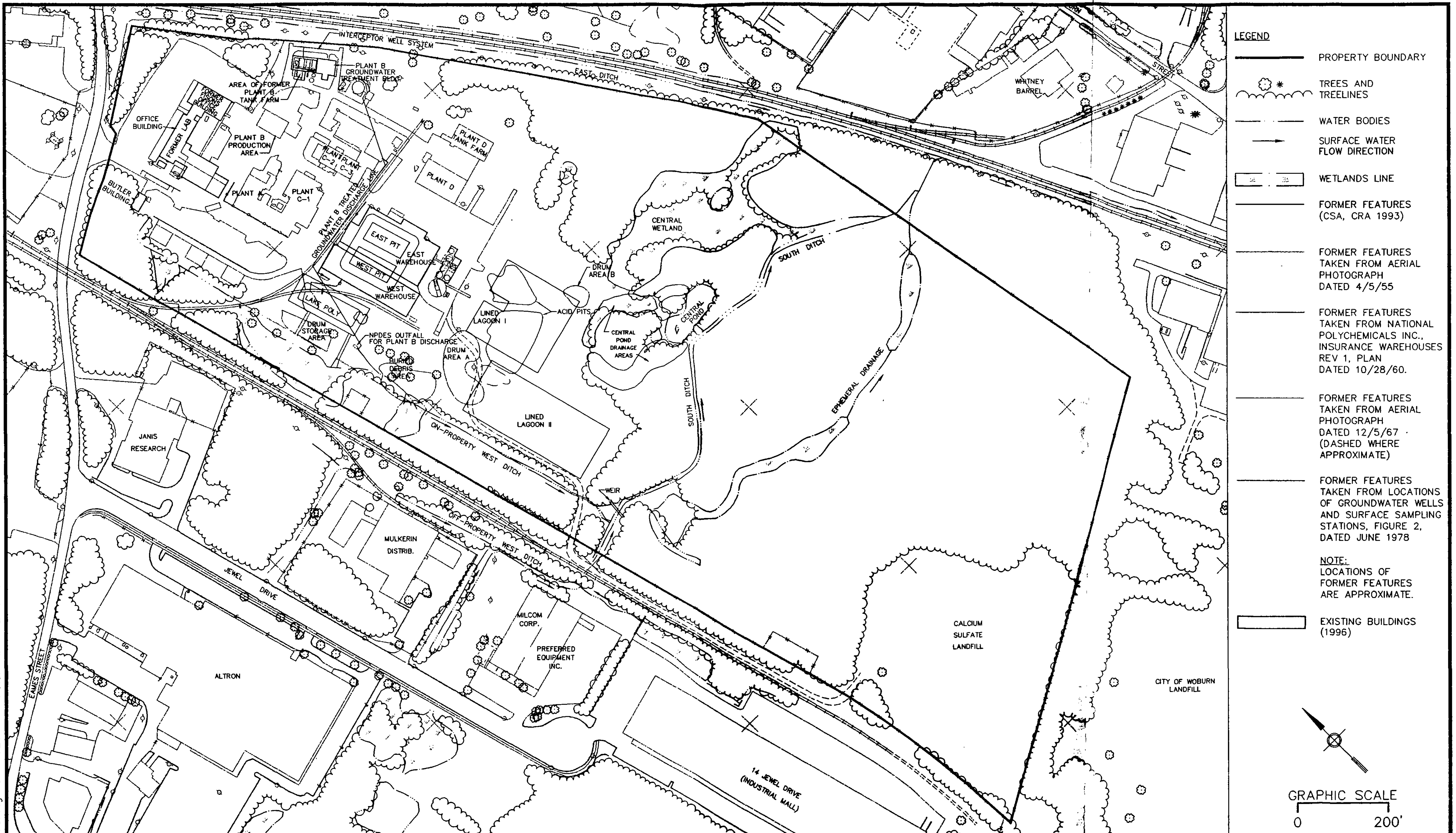
Olin Corporation
Wilmington, Massachusetts



Xrefs: OLIN-NEW.DWG
Dra...g: 7074-026

Project No. 00-7074-0102
May 30, 1997

Figure 2
Site Features Map

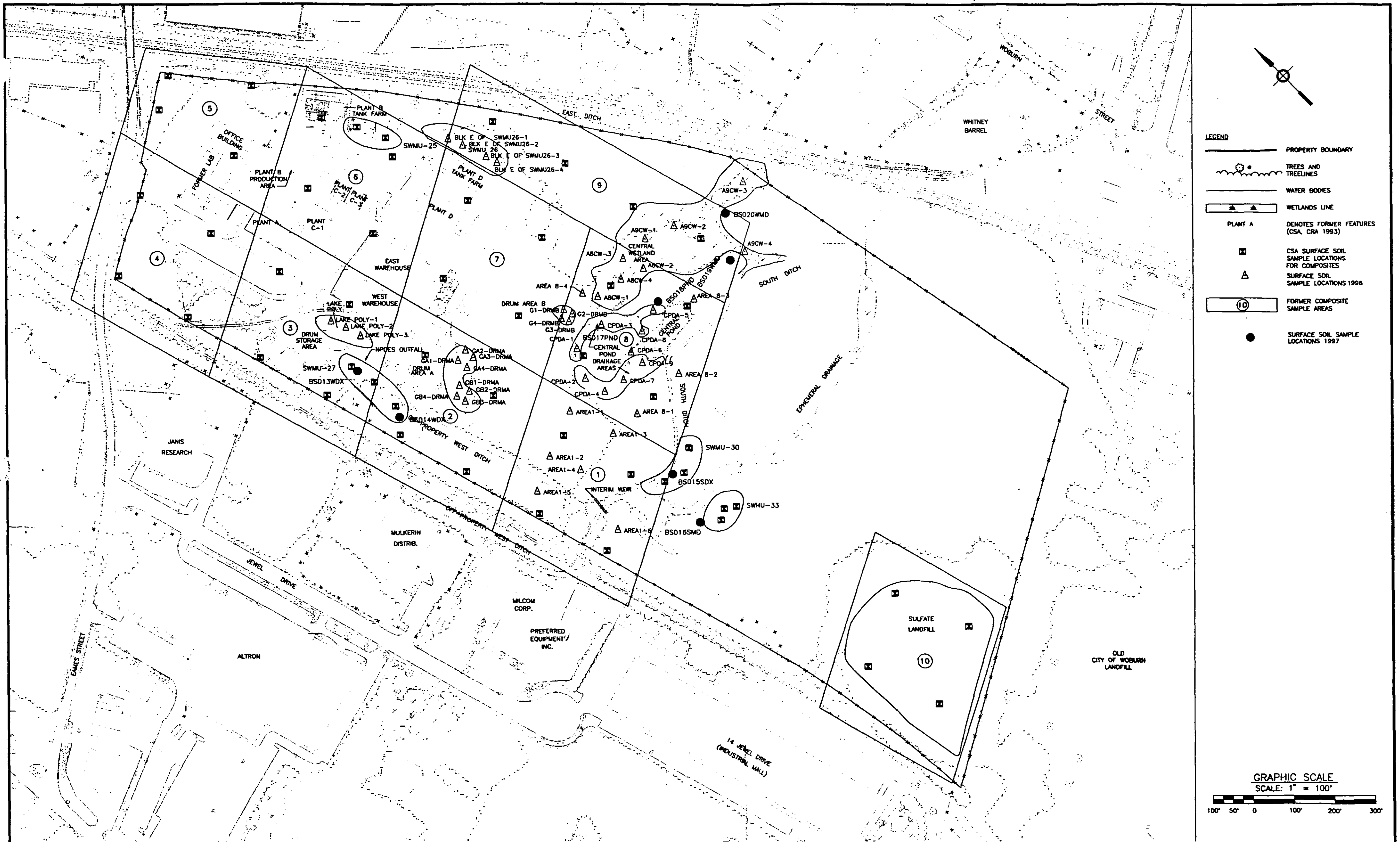


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FIGURE 3
SURFACE SOIL SAMPLE LOCATIONS

SCALE	AS SHOWN
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FIGURE	SSLOCS
SHEET	

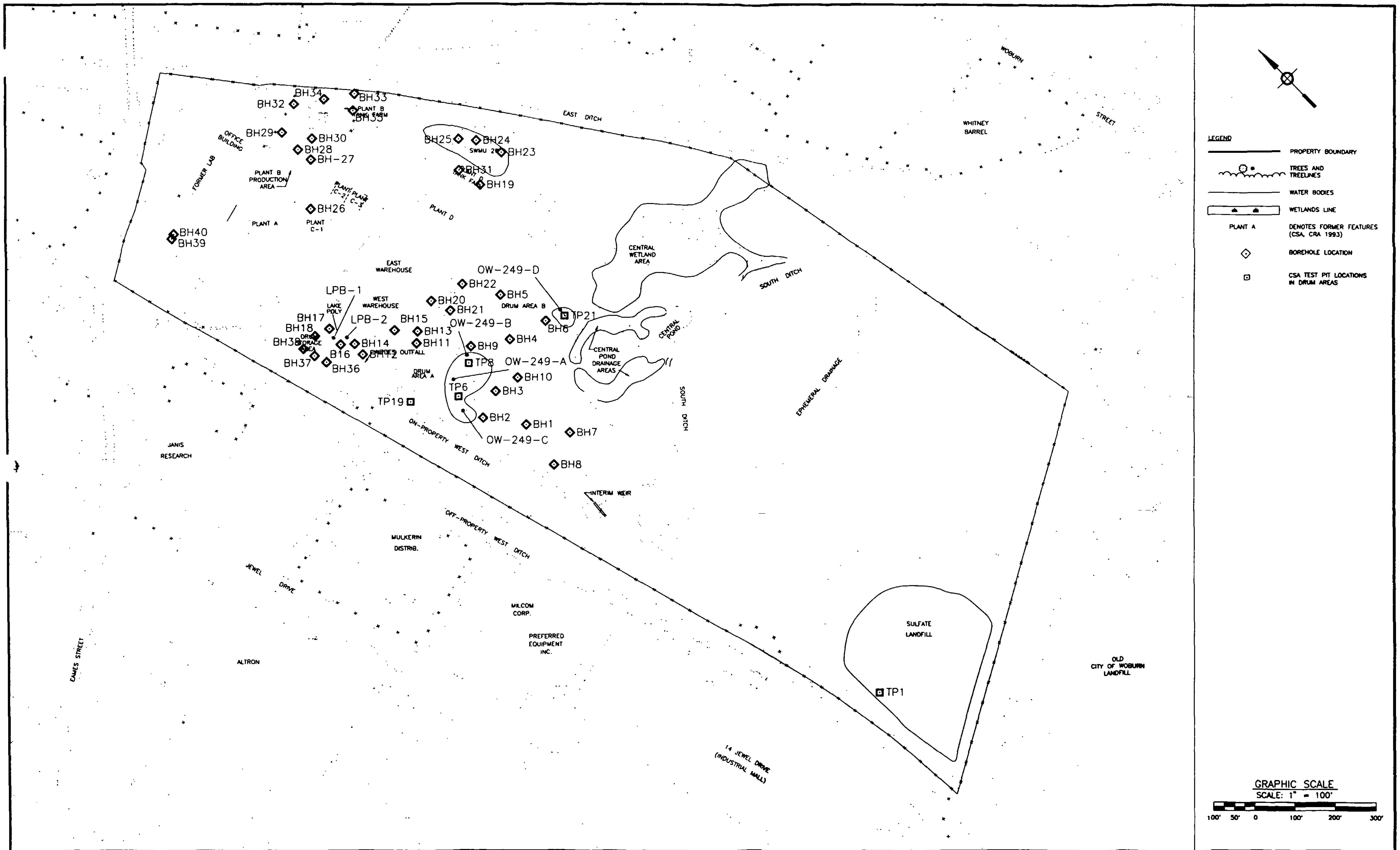

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FIGURE 5
SUBSURFACE SOIL SAMPLE LOCATIONS

SCALE	AS SHOWN
PROJECT NO.	00-7074-0102
	SUBSAMLOC
SHEET	

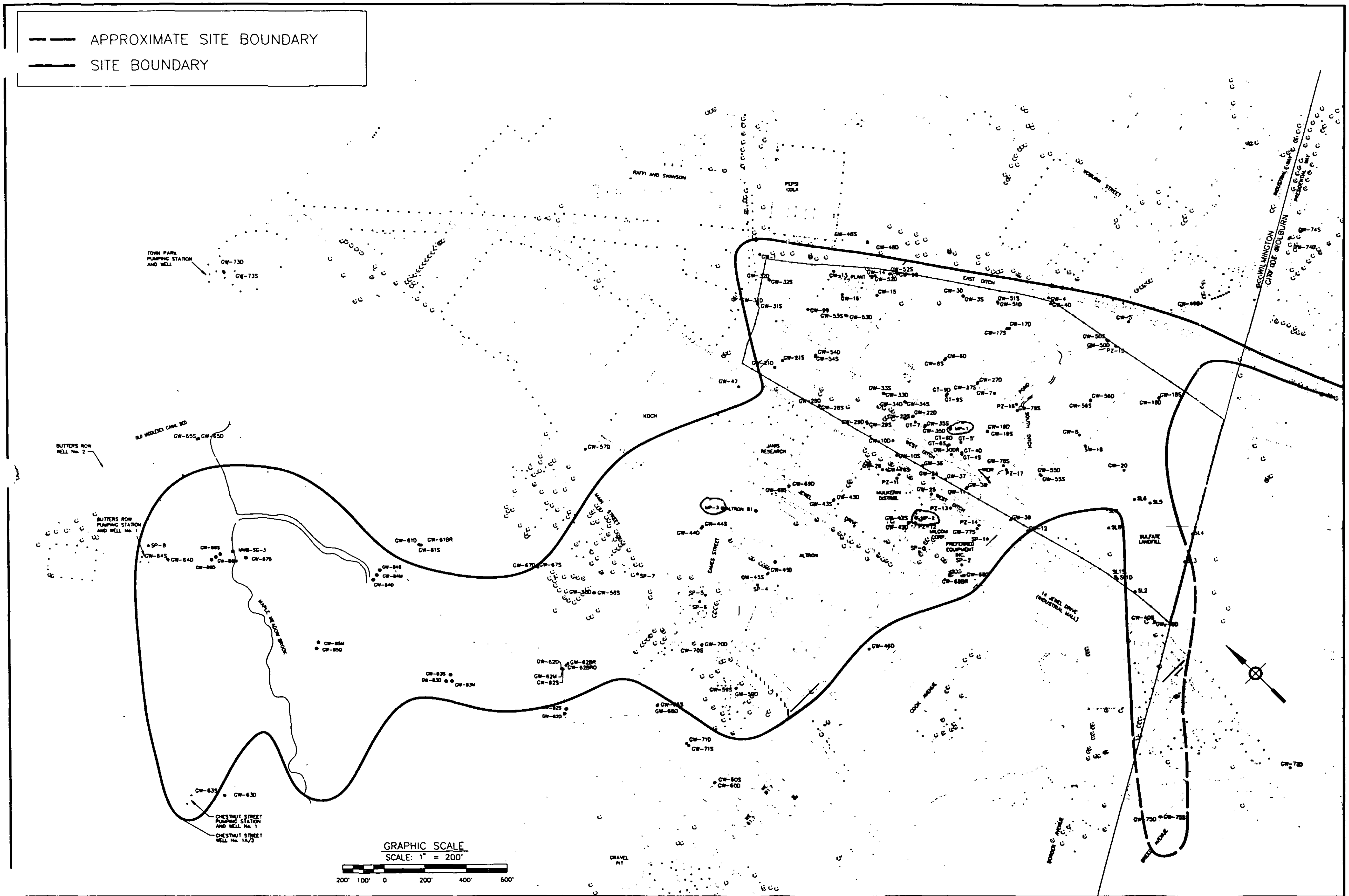

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FIGURE 6
GROUNDWATER SAMPLE LOCATIONS

SCALE	AS SHOWN
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	GWSAMPTS
SHEET	OF

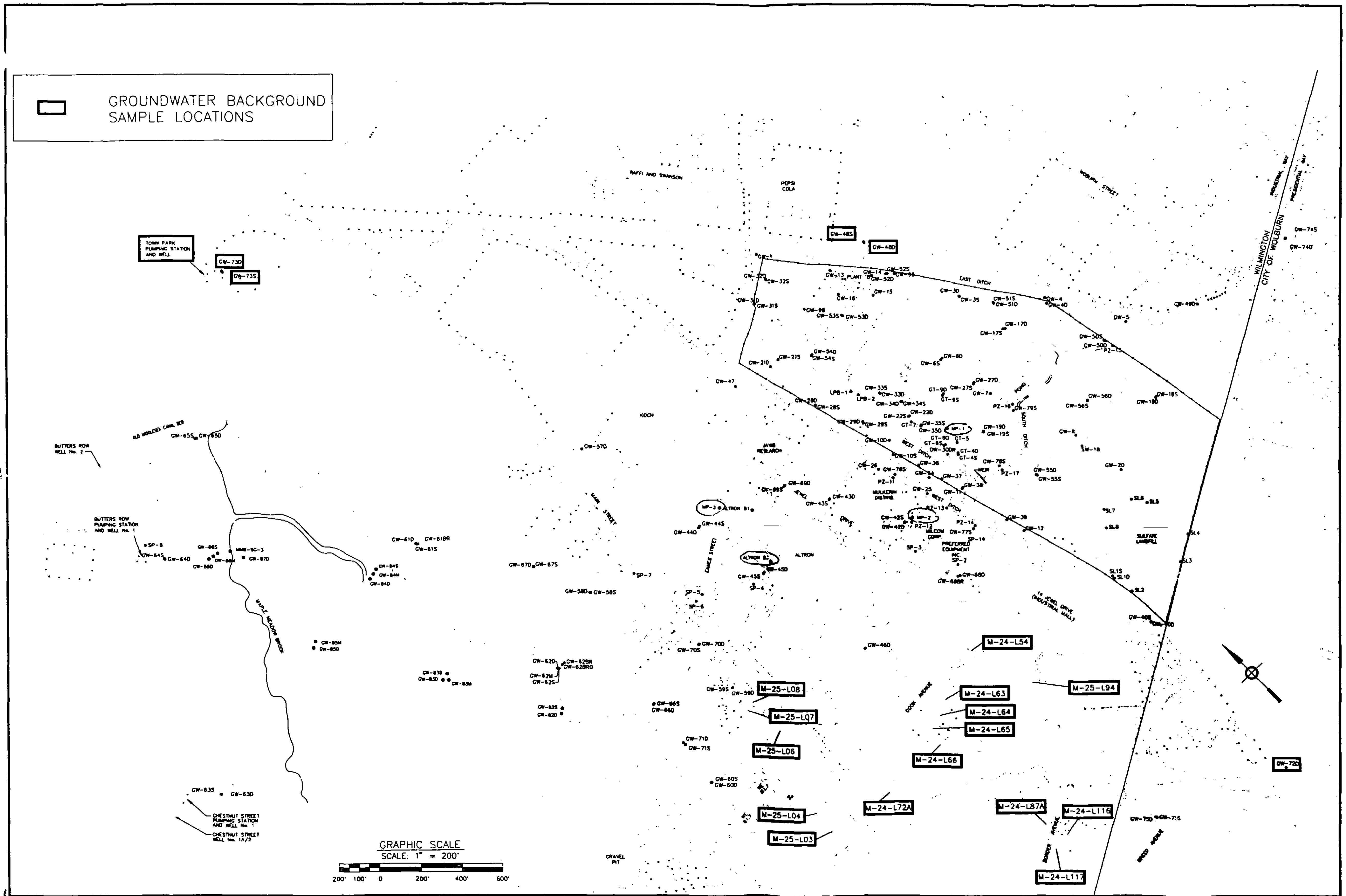

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FIGURE 7
GROUNDWATER BACKGROUND SAMPLE LOCATIONS

SCALE AS SHOWN
PROJECT NO. 00-7074-0102
SHEET

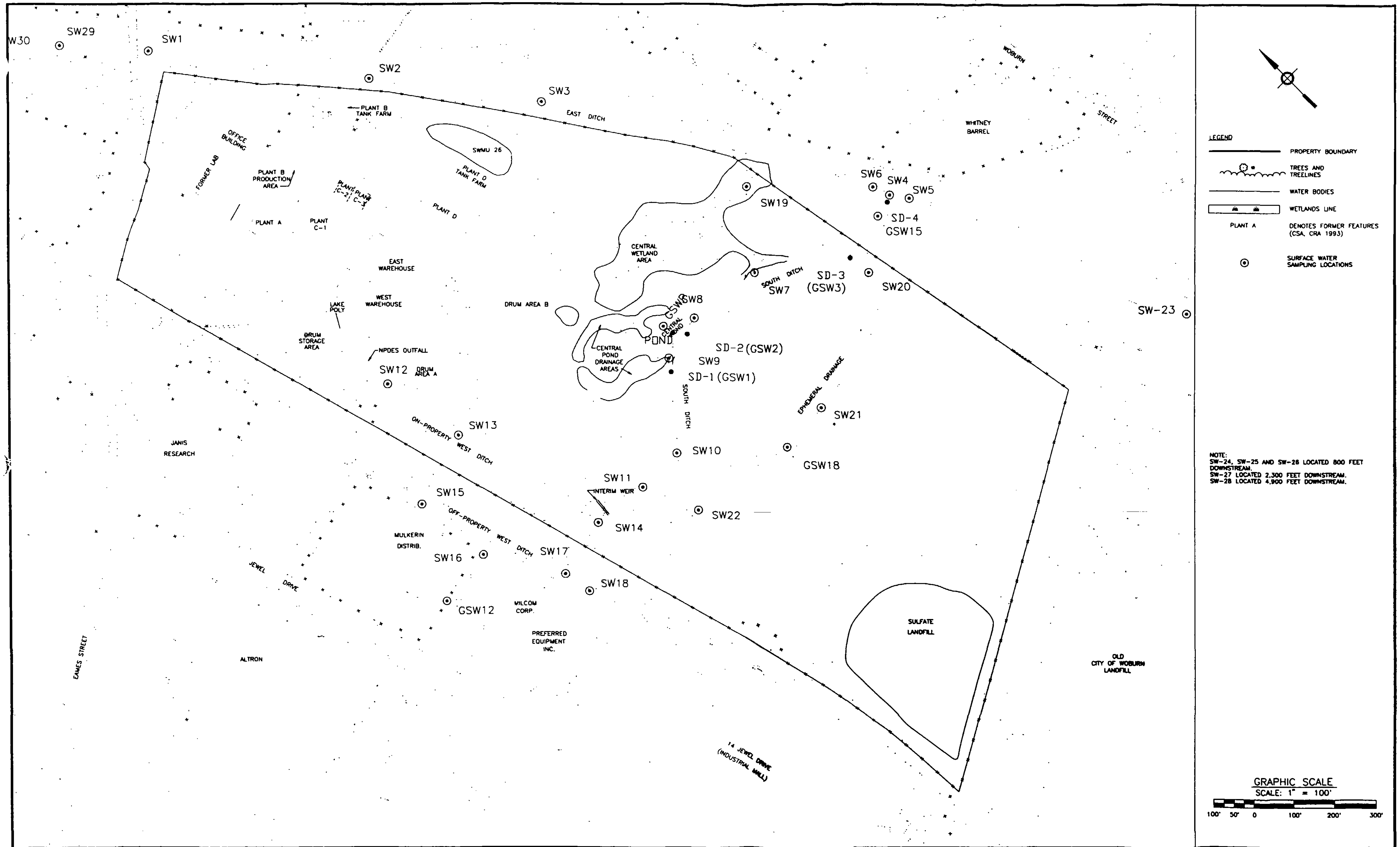

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FIGURE 8
SURFACE WATER SAMPLE LOCATIONS

SCALE	AS SHOWN
PROJECT NO.	00-7074-0102
FIG.SWTITLE	
SHEET	

Drawing 7074-035
Xefs OLIN-NEWDWG

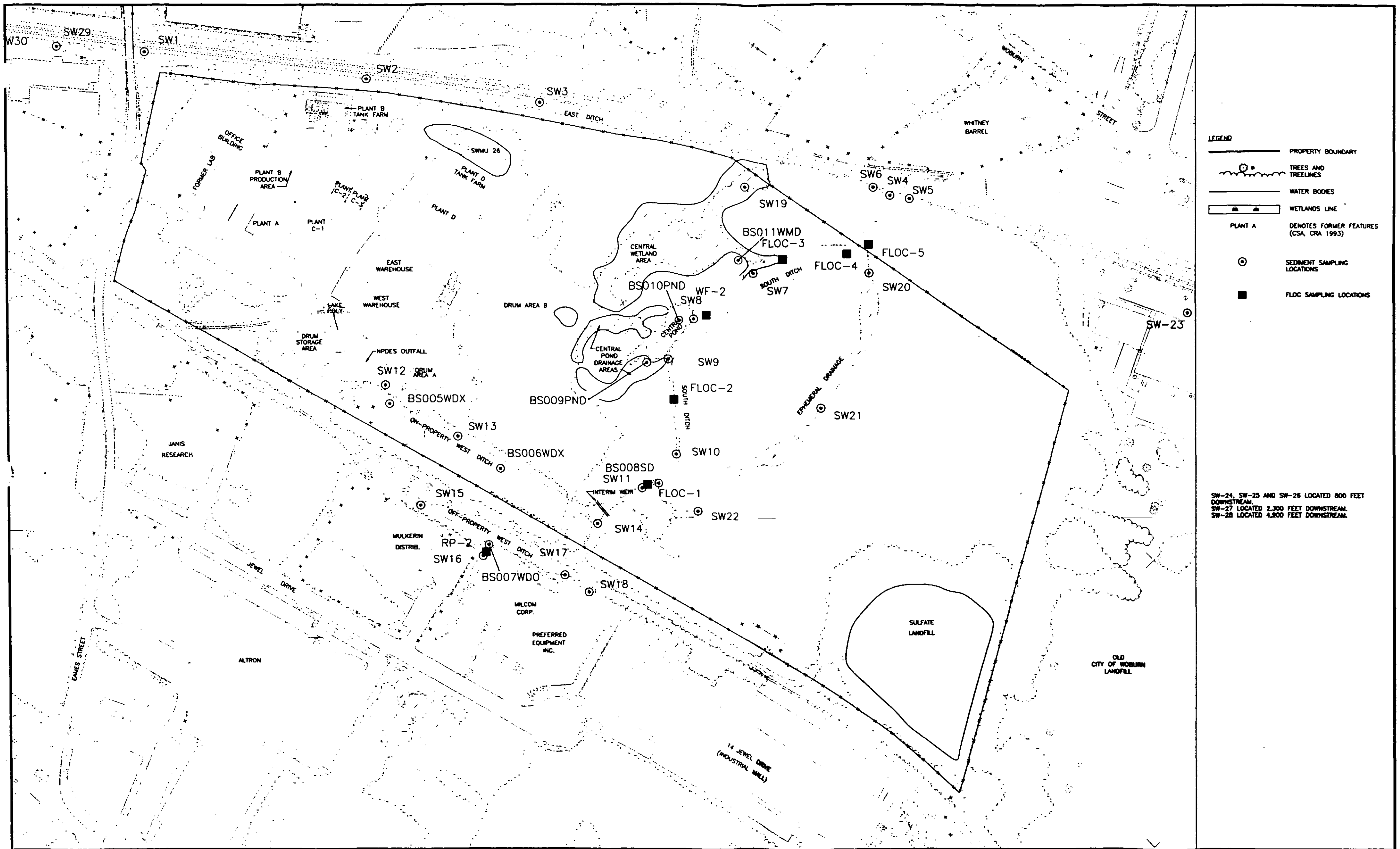

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FIGURE 9
SEDIMENT SAMPLE LOCATIONS

SCALE	
PROJECT NO.	
	OSEDLOC
SHEET	

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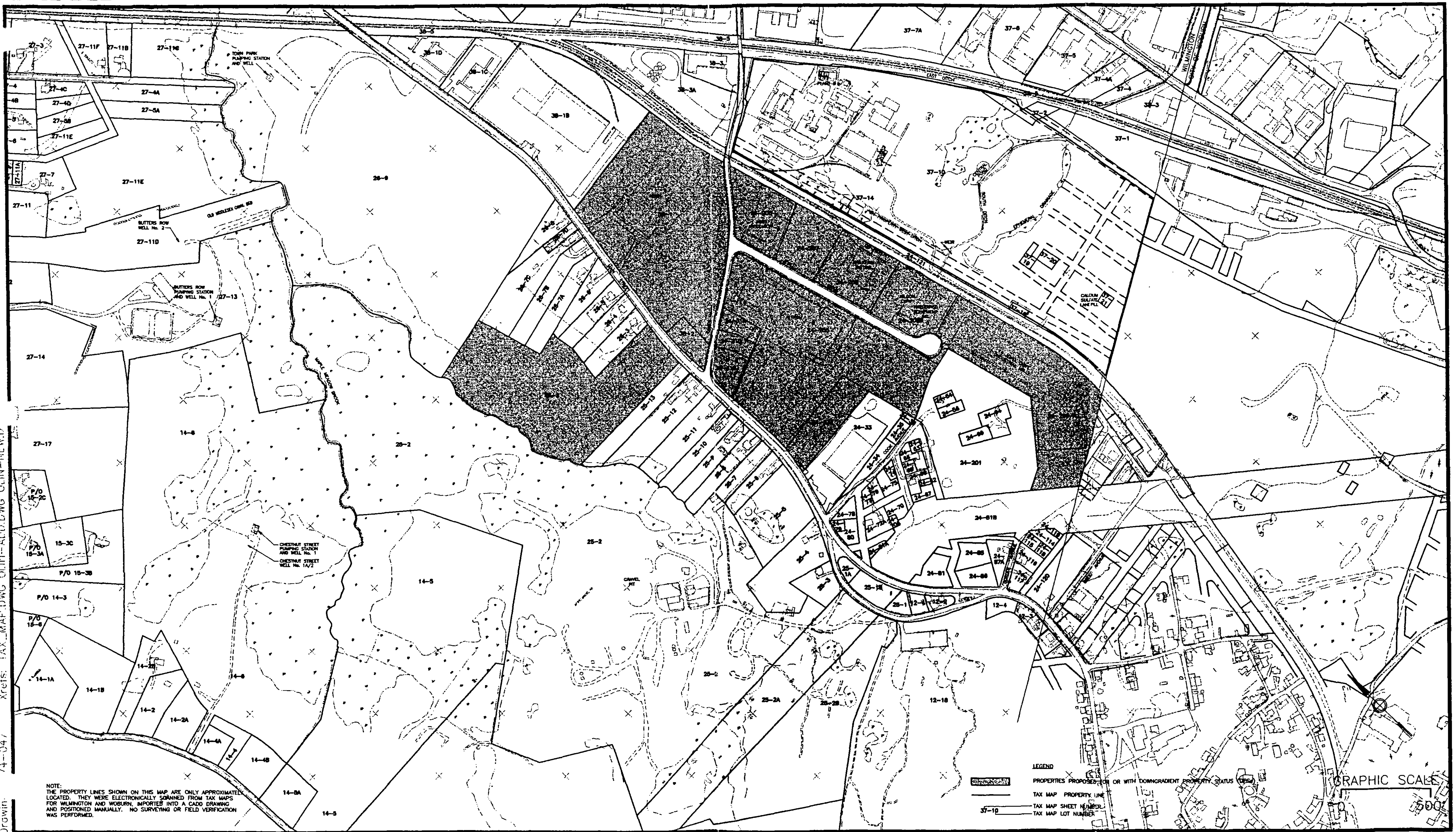

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June 13, 1997

Figure 11
Downgradient Property Status

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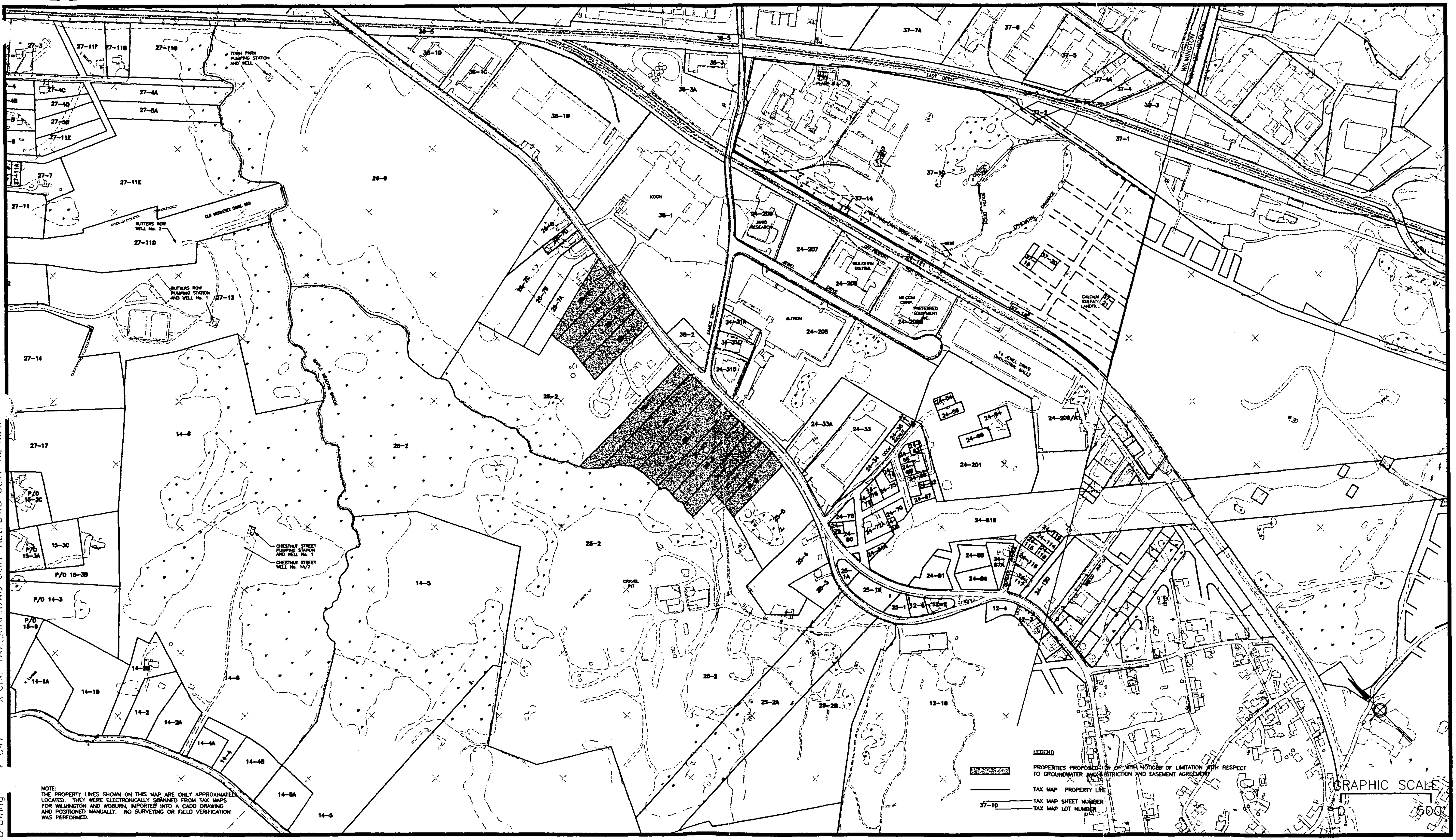

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Figure 10
Notices of Limitation

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FIGURE 12
ACTIVITY AND USE LIMITATIONS - FACILITY

SCALE: AS SHOWN
PROJECT NO. 00-7074-0102
ACTIVITYANDUSE
SHEET

Drawing: 7074-035

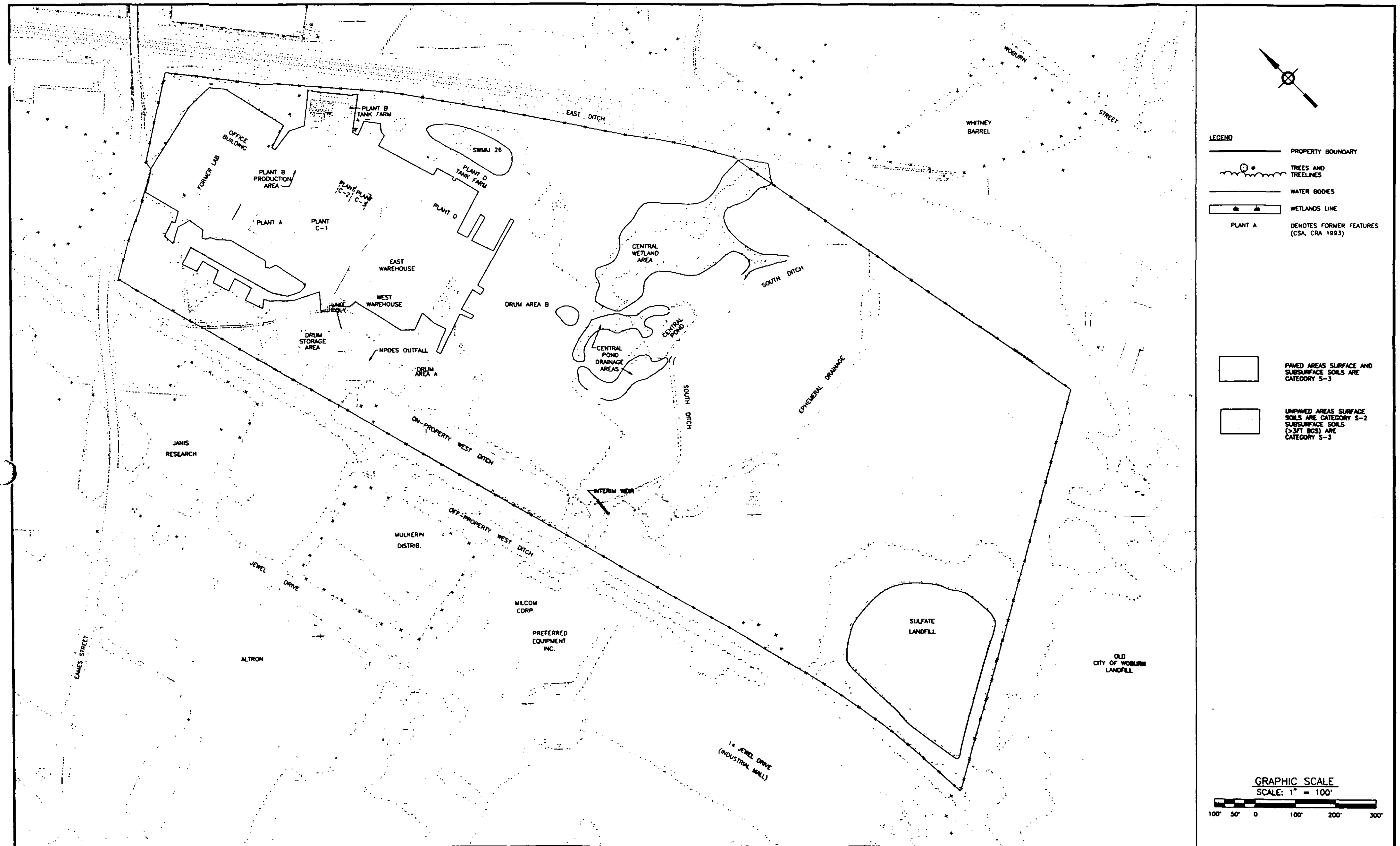

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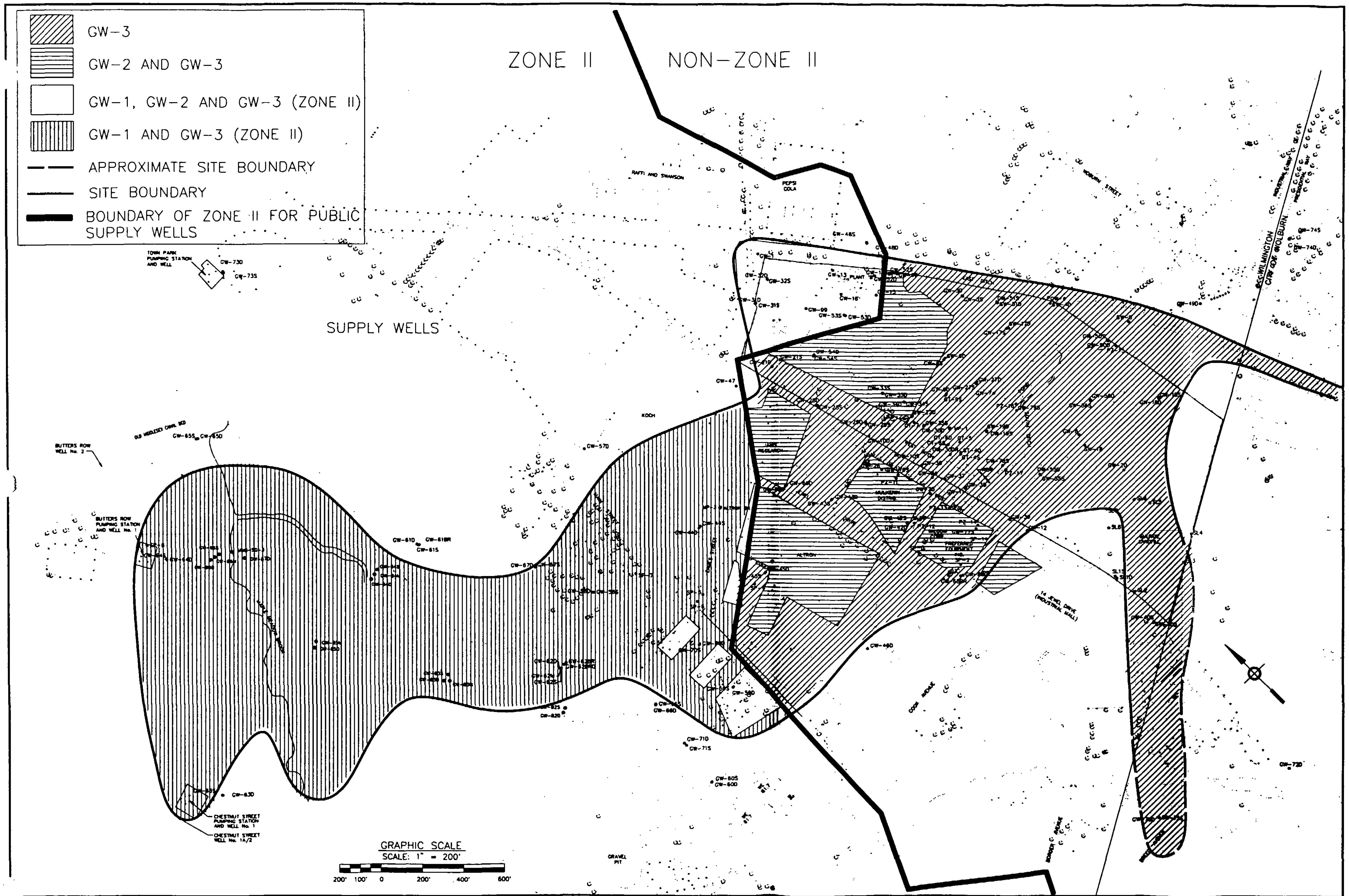
FIGURE 13
MCP SOIL CLASSIFICATIONS

SCALE	AS SHOWN
PROJECT NO.	00-7074-0102
	OMMCPSOIL
SHEET	

Drawing 7074-035
Xrefs OLIN-NEWDW



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PROJECT GEOLOGIST	APPROVED		
PROJECT MGR.			
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FIGURE 14
MCP GROUNDWATER CLASSIFICATION

SCALE	AS SHOWN
PROJECT NO.	00-7074-0102
	OMCP_GW_CL
SHEET	

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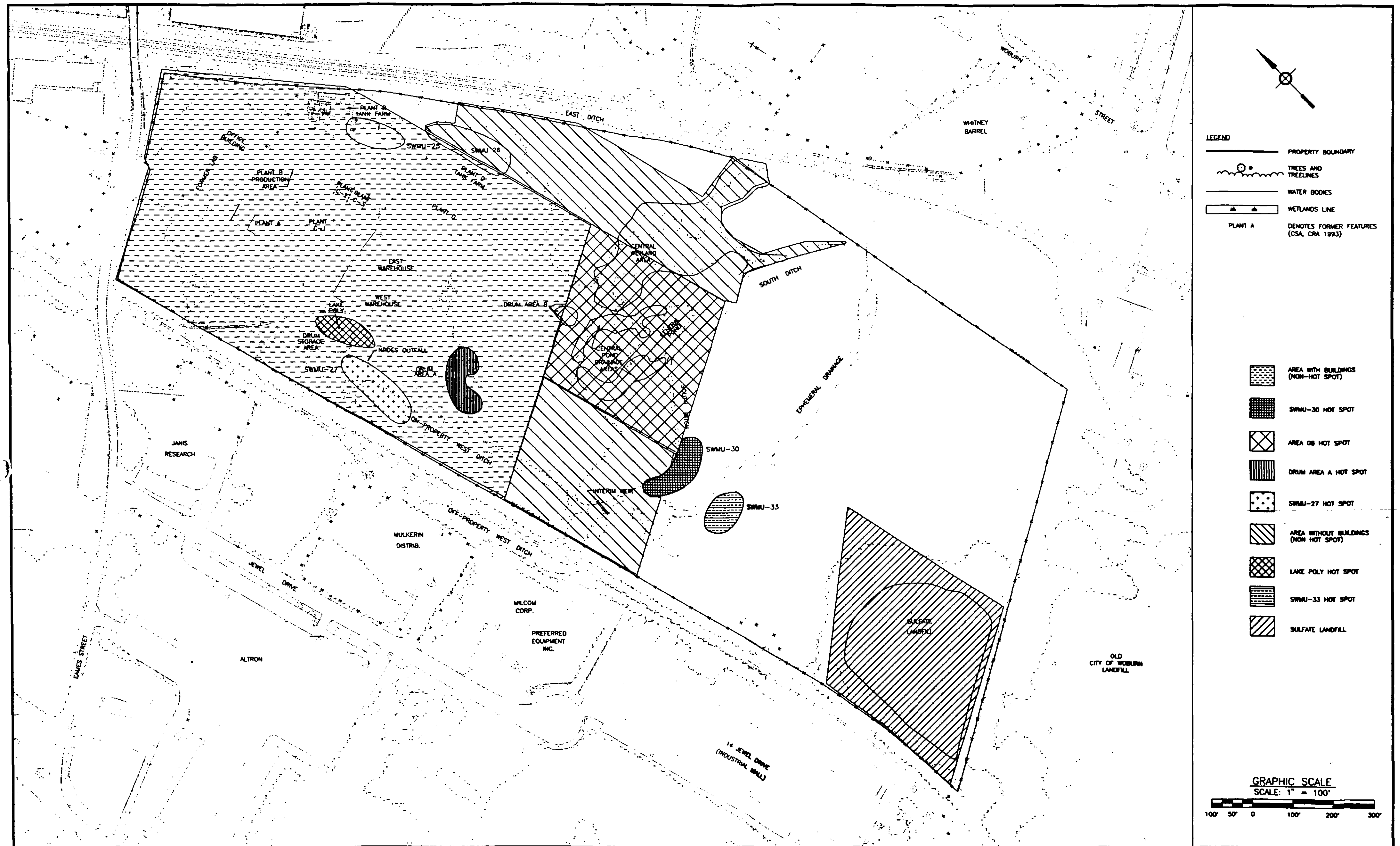

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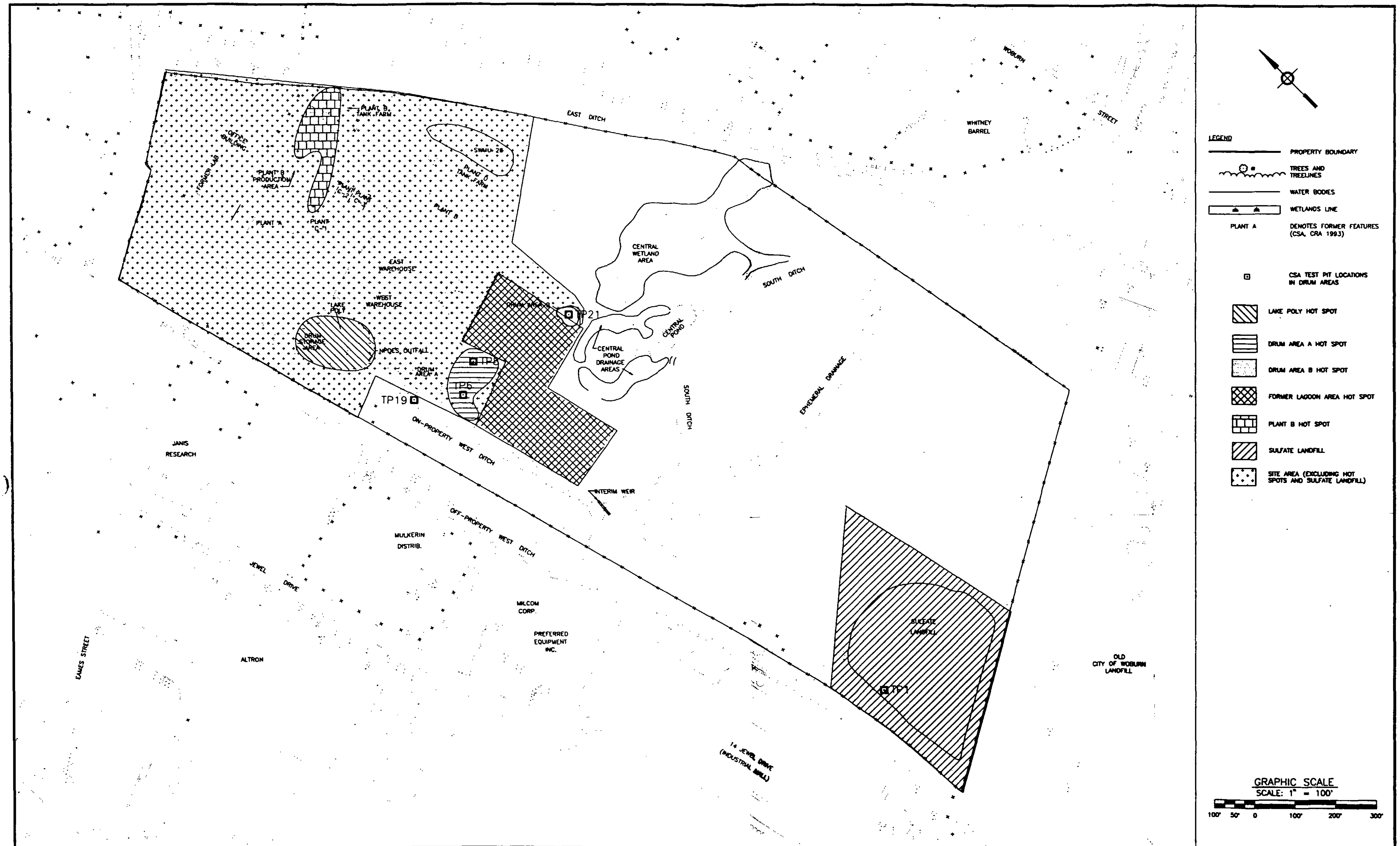
FIGURE 15
SURFACE SOIL EXPOSURE POINTS

SCALE AS SHOWN
PROJECT NO. 00-7074-0102
DHHEP
SHEET

Drawing 7074-035
Scale OLN-NEWDWC



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PROJECT MGR.		
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FIGURE 16
SUBSURFACE SOIL EXPOSURE POINTS

SCALE	AS SHOWN
PROJECT NO.	00-7074-0102
	OHHSUB
SHEET	

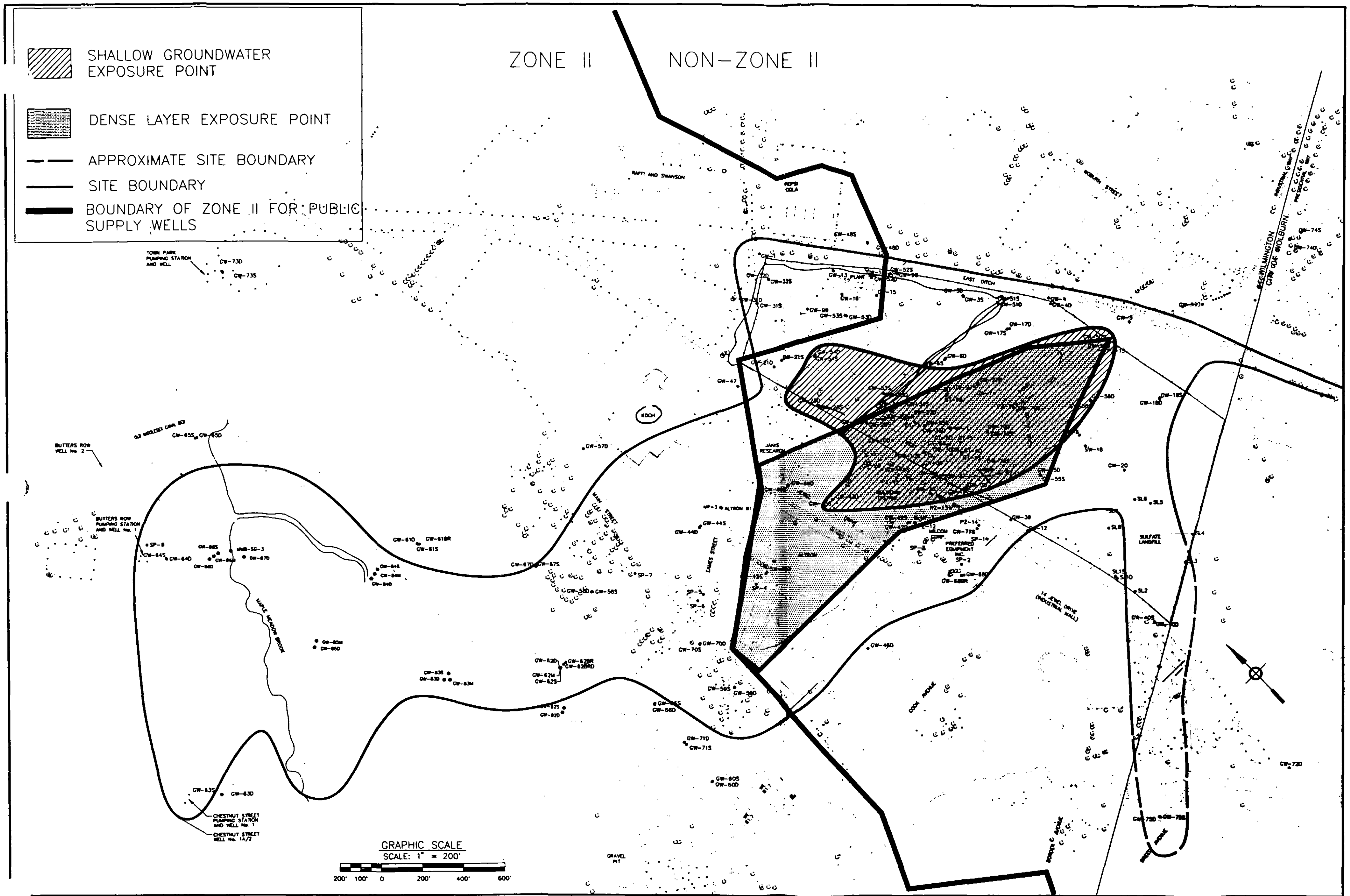

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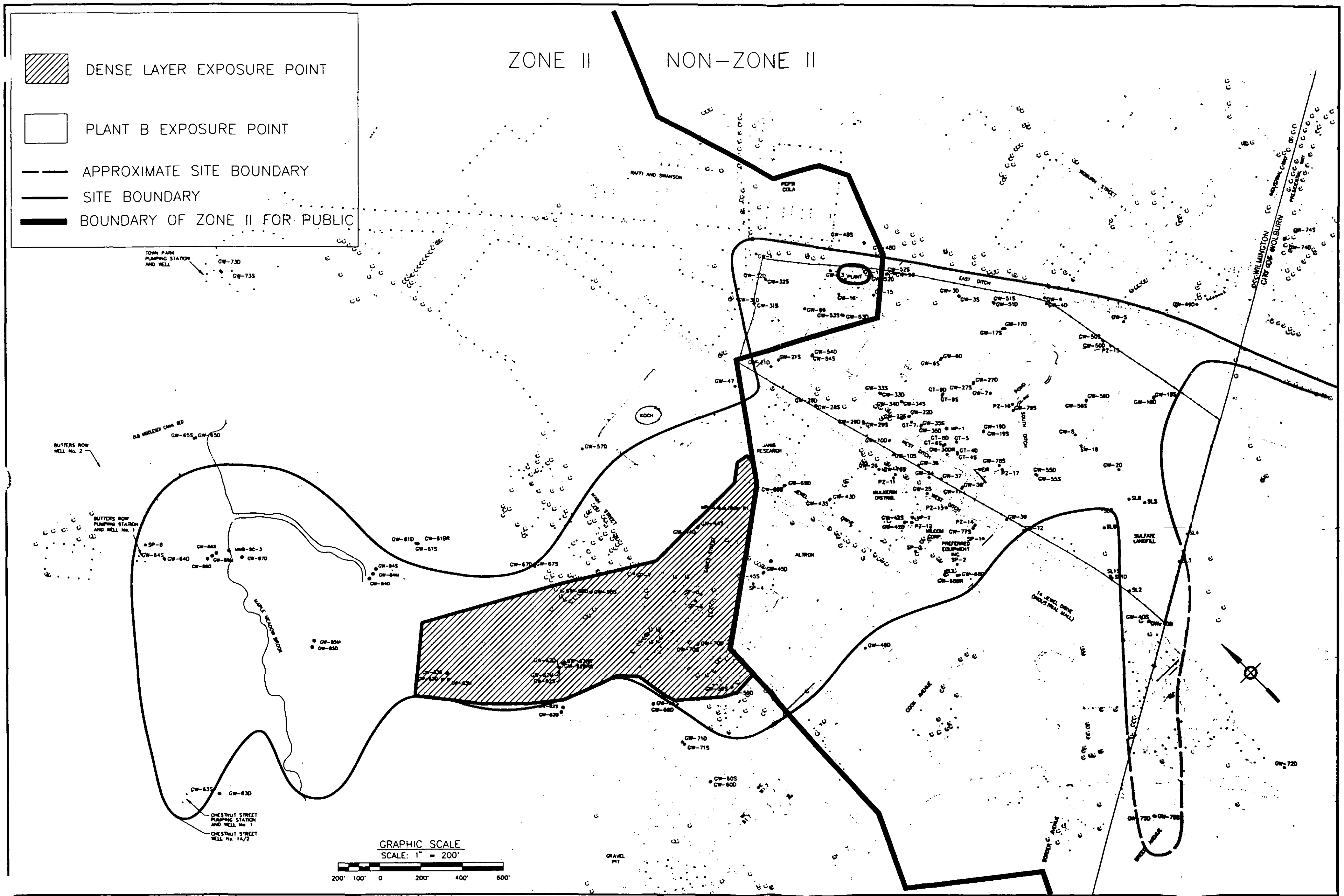
FIGURE 17
NON-ZONE II GROUNDWATER EXPOSURE POINTS

SCALE: AS SHOWN
PROJECT NO. 00-7074-0102
OSCEP
DATE: 10/14/96



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PROJECT GEOLOGIST	APPROVED		
PROJECT MGR.			
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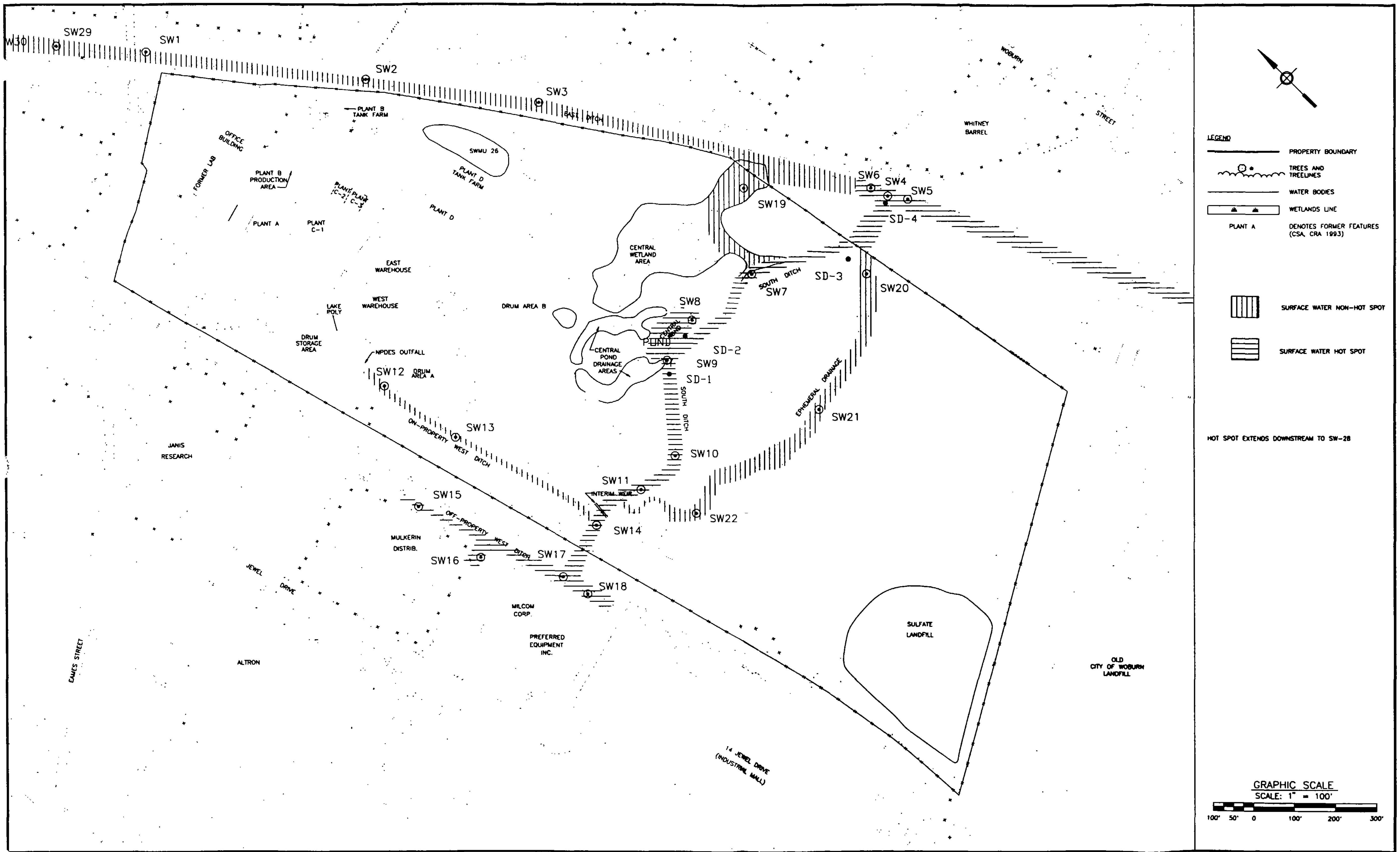
FIGURE 18
ZONE II GROUNDWATER
EXPOSURE POINTS

SCALE: AS SHOWN
PROJECT NO. 00-7074-0102
SHEET

NO	REVISIONS	DATE	CHKR	NO	REVISIONS	DATE	CHKR	DATE	ISSUED FOR



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PROJECT GEOLOGIST | APPROVED
PROJECT MGR.
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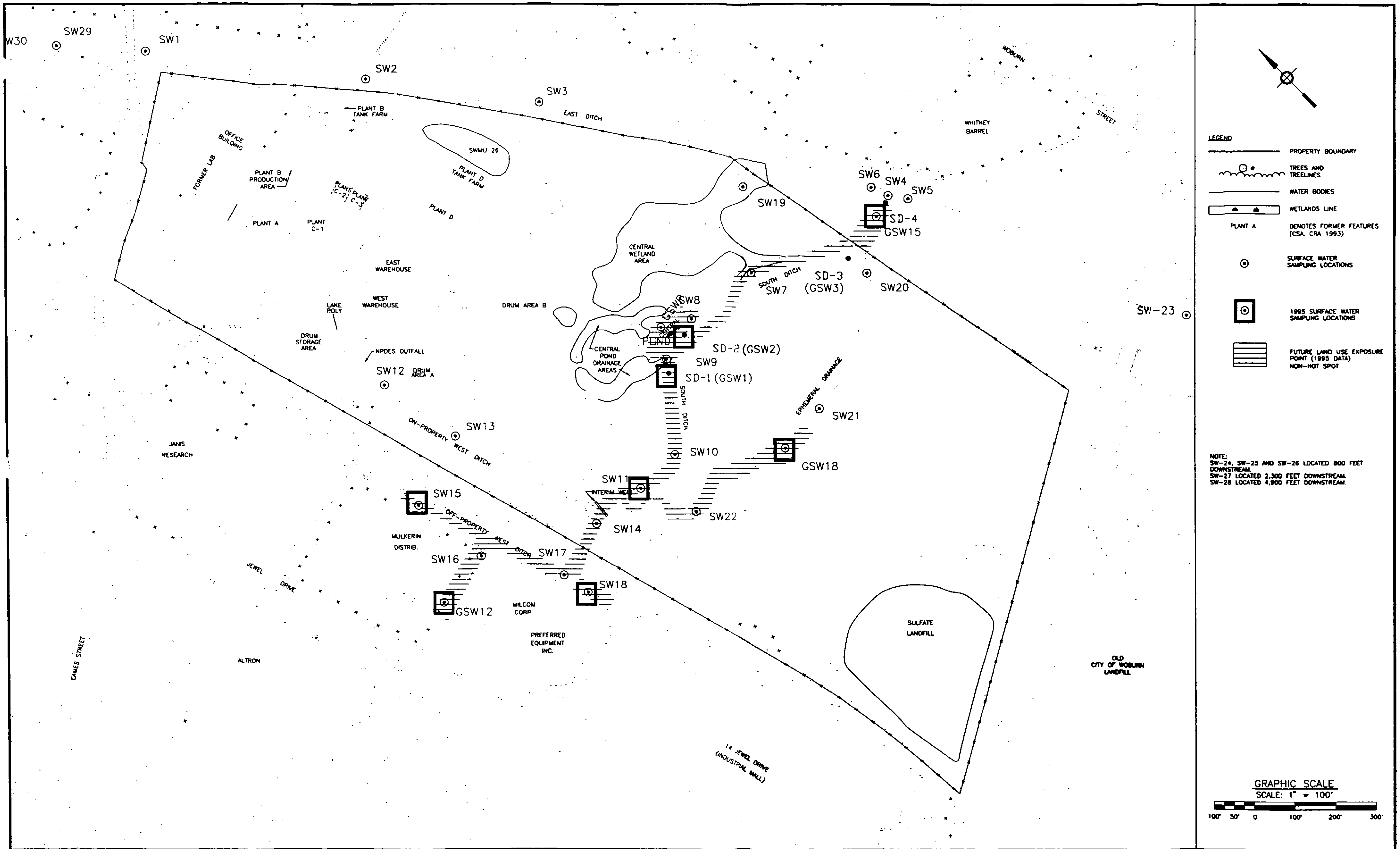
FIGURE 19
SURFACE WATER EXPOSURE POINTS
FUTURE LAND USE
HISTORICAL DATA

SCALE: AS SHOWN
PROJECT NO. 00-7074-0102
OSWFUHI
SHEET

Drawing 7074-035
Xrefs OLIN-NEW.DWG



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PROJECT MGR.	
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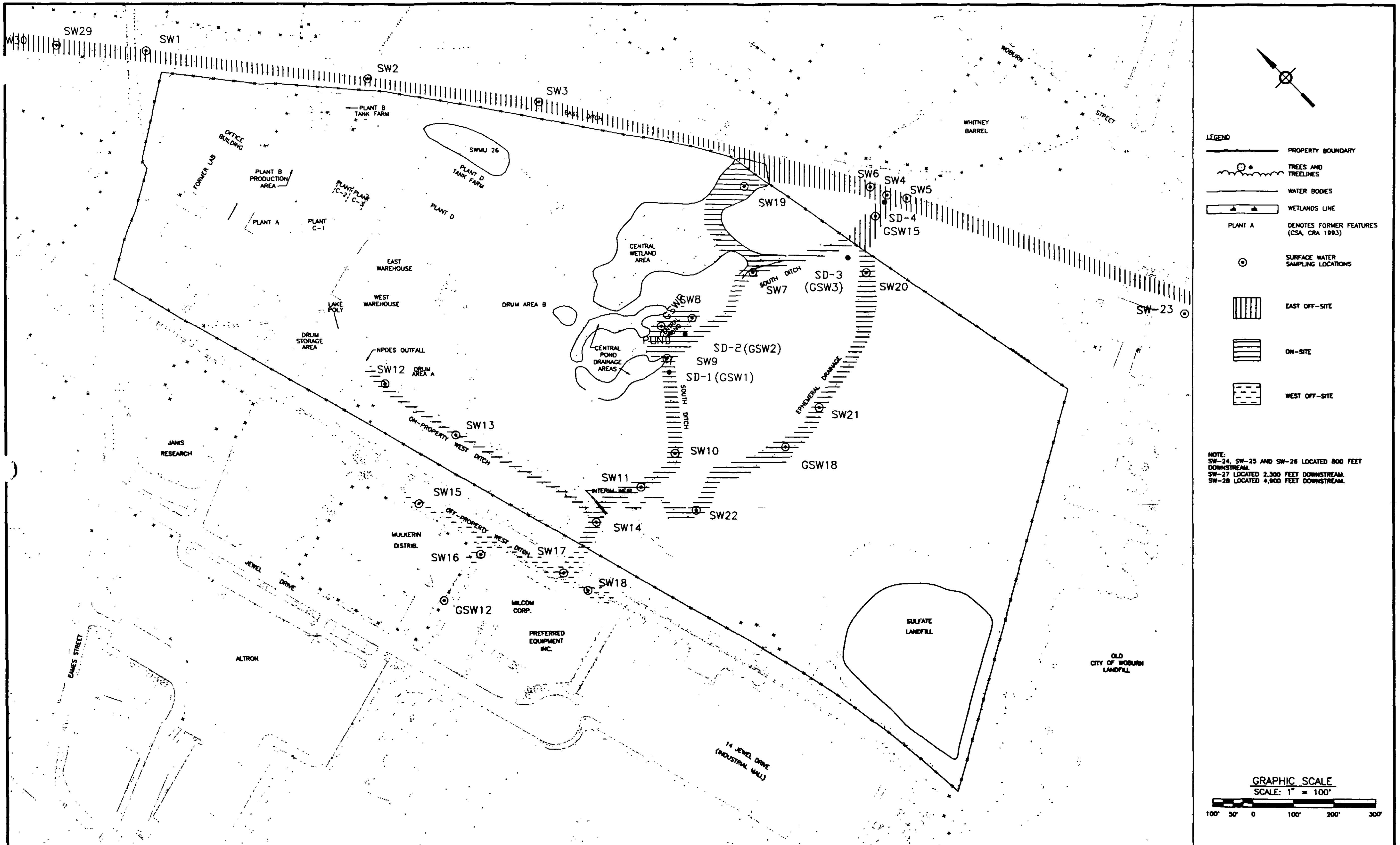
FIGURE 21
SURFACE WATER EXPOSURE POINTS
FUTURE LAND USE
1995 ANALYTICAL DATA

SCALE	AS SHOWN
PROJECT NO.	00-7074-0102
	OSWFUAD
SHEET	



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PROJECT MGR.		
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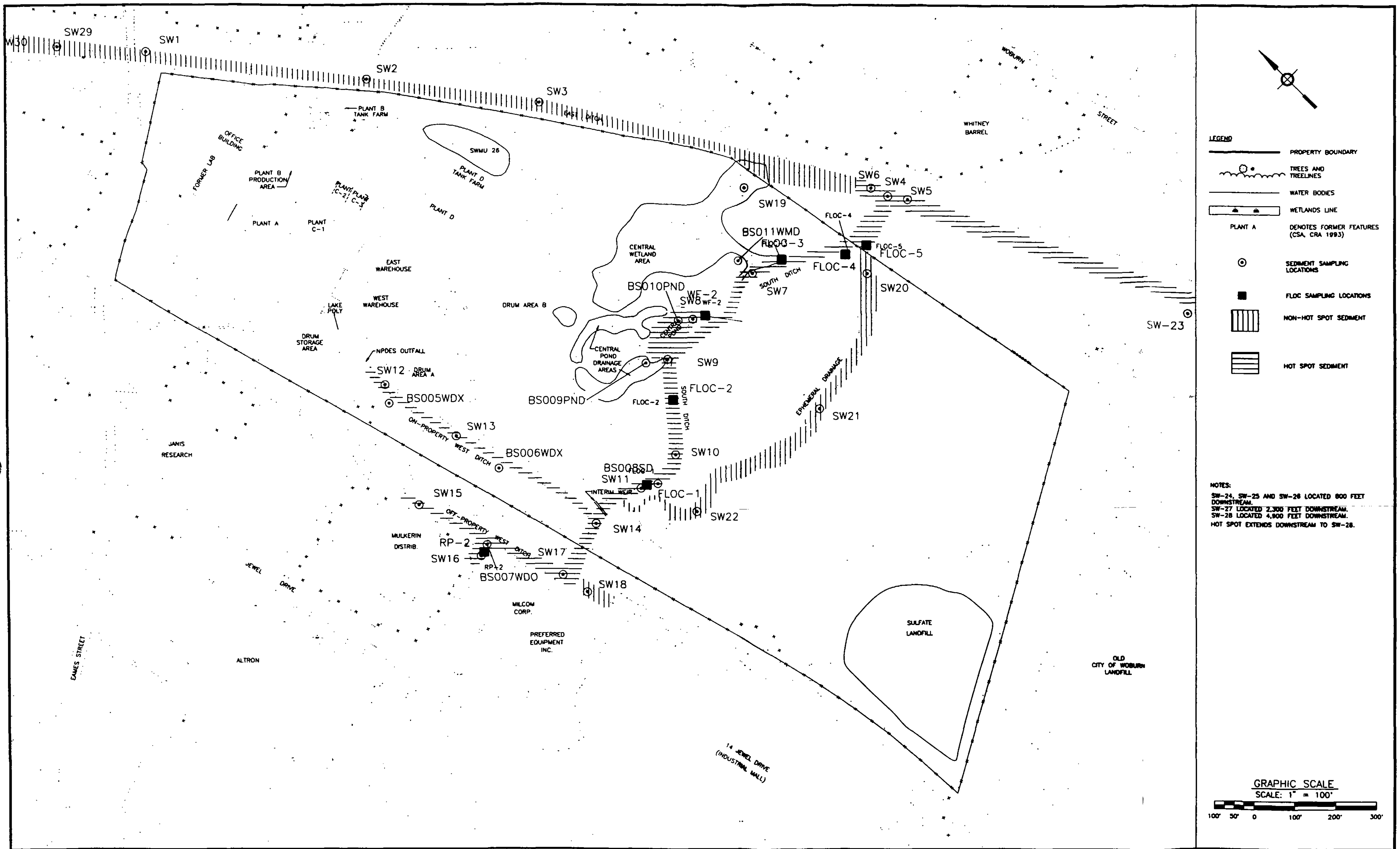
FIGURE 20
SURFACE WATER EXPOSURE POINTS
CURRENT LAND USE
HISTORICAL DATA

SCALE: AS SHOWN
PROJECT NO. 00-7074-0102
SWCUHI
SHEET

REGISTERED



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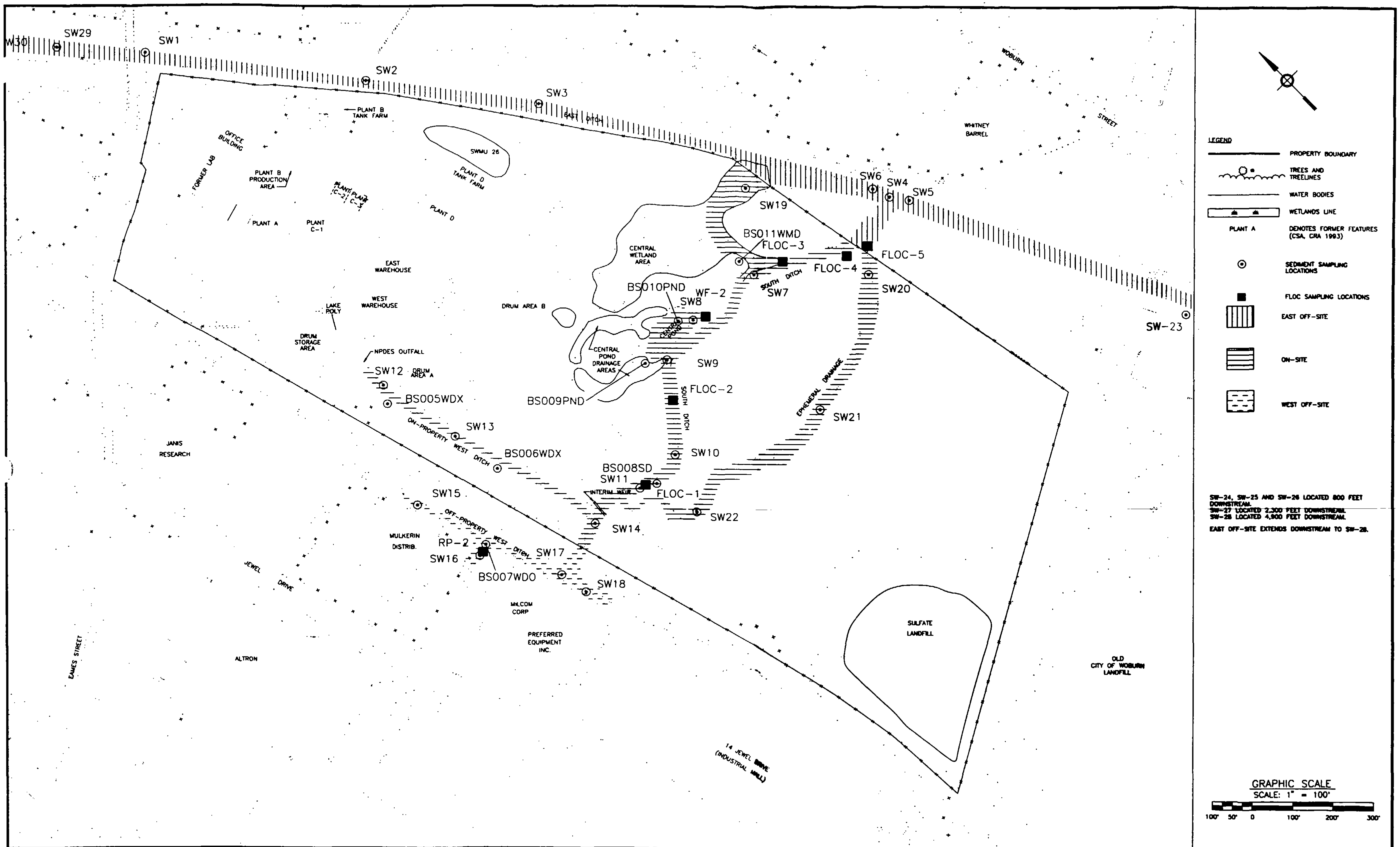
DRAWN BY			
PROJECT GEOLOGIST	APPROVED		
PROJECT MGR.			
CHECKED BY	DATE	REGISTERED	

OLIN CORPORATION
Wilmington, Massachusetts

FIGURE 22
SEDIMENT EXPOSURE POINTS
FUTURE LAND USE

SCALE AS SHOWN
PROJECT NO. 00-7074-0102
OSEDFU
SHEET



NO.	REVISIONS	DATE	ENGR	DATE	ISSUED FOR

SMITH SMITH TECHNOLOGY CORPORATION

One Plymouth Meeting
Plymouth Meeting, PA 19462

PROJECT HYDROGEOLOGIST	APPROVED	SEAL	
DRAWN BY			
PROJECT GEOLOGIST	APPROVED		
PROJECT MGR.			
CHECKED BY	DATE	REGISTERED	

OLIN CORPORATION
Wilmington, Massachusetts

FIGURE 23
SEDIMENT EXPOSURE POINTS
CURRENT LAND USE

SCALE AS SHOWN
PROJECT NO. 00-7074-0102
0SEDCU
SHEET

TABLES

TABLE 1
IDENTIFICATION OF HUMAN HEALTH OHM OF CONCERN - SURFACE SOIL

Olin Corporation
Wilmington, MA Facility

OHM	Site Data/Concentration [1]							Background Concentration [2]		OHM of Concern? [3]	Reason [4]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Median	Median	Maximum		
VOCs (mg/Kg)											
1,1,1-Trichloroethane	0.005 :	0.016	26 / 60	0.002	0.23	0.0106	0.007	NB		Yes	
1,1-Dichloroethane	0.005 :	0.016	1 / 60	0.001	0.001	0.0033	0.006	NB		No	FC
1,1-Dichloroethene	0.005 :	0.016	1 / 60	0.018	0.018	0.0036	0.006	NB		Yes	
1,2-Dichloroethane	0.005 :	0.016	1 / 60	0.001	0.001	0.0033	0.006	NB		No	FC
2,4,4-Trimethyl-1-pentene	0.005 :	0.3	5 / 60	0.0008	0.014	0.0067	0.006	NB		Yes	
2,4,4-Trimethyl-2-pentene	0.005 :	0.039	2 / 60	0.001	0.005	0.0043	0.006	NB		No	FC
2-Butanone (MEK)	0.01 :	0.05	3 / 60	0.001	0.004	0.0074	0.013	NB		Yes	
4-Methyl-2-Pentanone (MIBK)	0.01 :	0.05	1 / 60	0.007	0.007	0.0074	0.013	NB		No	FC
Acetone	0.012 :	0.025	43 / 60	0.005	0.093	0.0173	0.015	NB		Yes	
Benzene	0.005 :	0.016	1 / 60	0.001	0.001	0.0033	0.006	NB		No	FC
Methylene Chloride	0.005 :	0.041	14 / 60	0.002	0.047	0.006	0.006	NB		Yes	
Styrene	0.005 :	0.016	1 / 60	0.001	0.001	0.0033	0.006	NB		No	FC
Tetrachloroethene (PCE)	0.005 :	0.014	3 / 60	0.001	0.073	0.0043	0.006	NB		Yes	
Toluene	0.005 :	0.013	14 / 60	0.0006	0.015	0.0034	0.006	NB		Yes	
Trichloroethene (TCE)	0.005 :	0.016	2 / 60	0.007	0.009	0.0035	0.006	NB		No	FC
Xylenes, Total	0.005 :	0.016	1 / 60	0.002	0.002	0.0033	0.006	NB		No	FC
SVOCs (mg/Kg)											
1,2,4-Trichlorobenzene	0.3 :	160	1 / 46	0.25	0.25	2.9883	0.645	ND		No	FC
2-Methylnaphthalene	0.33 :	37	4 / 47	0.007	560	13.1702	0.63	ND		Yes	
2-Methylphenol (o-Cresol)	0.33 :	160	2 / 47	0.02	0.049	2.9672	0.66	ND		No	FC
4-Methylphenol(p-Cresol)	0.33 :	160	1 / 47	0.34	0.34	2.9776	0.66	ND		No	FC
Acenaphthene	0.33 :	37	1 / 47	170	170	4.8893	0.66	ND		Yes	
Acenaphthylene	0.33 :	37	8 / 47	0.008	420	10.1661	0.58	ND		Yes	
Anthracene	0.33 :	37	12 / 47	0.002	290	7.3247	0.56	ND		Yes	
Benzo(a)Anthracene	0.33 :	37	17 / 47	0.008	140	4.1683	0.48	ND		Yes	
Benzo(a)Pyrene	0.35 :	37	13 / 47	0.011	100	3.3288	0.48	ND		Yes	
Benzo(b)Fluoranthene	0.38 :	37	17 / 47	0.01	44	2.1395	0.48	0.06	0.062	Yes	
Benzo(g,h,i)Perylene	0.33 :	37	5 / 47	0.029	29	1.8678	0.61	ND		Yes	
Benzo(k)Fluoranthene	0.33 :	37	15 / 47	0.006	66	2.5988	0.48	ND		Yes	
Benzoic Acid	1.6 :	770	15 / 47	0.039	1.8	13.9102	2.4	ND		Yes	
Butylbenzylphthalate	0.33 :	160	6 / 46	0.029	2.6	3.0265	0.61	ND		Yes	
Chrysene	0.39 :	37	18 / 47	0.012	150	4.3959	0.5	ND		Yes	
Di-n-butylphthalate	0.33 :	160	33 / 46	0.009	10	2.1565	0.067	ND		Yes	
Di-n-octylphthalate	0.33 :	160	6 / 46	0.012	4.7	3.0617	0.61	ND		Yes	
Dibenzo(a,h)Anthracene	0.33 :	160	1 / 47	0.074	0.074	2.9687	0.66	ND		No	FC
Dibenzofuran	0.33 :	37	2 / 47	0.016	39	2.1002	0.66	ND		Yes	
Diethylphthalate	0.33 :	160	14 / 47	0.01	0.085	2.8508	0.56	ND		Yes	
'methylphthalate	0.33 :	160	1 / 47	0.064	0.064	2.9688	0.66	ND		No	FC

TABLE 1
IDENTIFICATION OF HUMAN HEALTH OHM OF CONCERN - SURFACE SOIL

Olin Corporation
Wilmington, MA Facility

OHM	Site Data/Concentration [1] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Median	Background Concentration [2] Median	Maximum	OHM of Concern? [3]	Reason [4]
Fluoranthene	0.39 :	37	25 / 47	0.008	410	9.8421	0.39	0.057	0.066	Yes	
Fluorene	0.33 :	37	3 / 47	0.008	430	10.4149	0.66	ND		Yes	
Indeno (1,2,3-cd)Pyrene	0.33 :	37	11 / 47	0.031	24	1.7117	0.49	ND		Yes	
N-Nitrosodiphenylamine	0.33 :	160	14 / 45	0.059	210	7.6279	0.555	ND		Yes	
Naphthalene	0.33 :	37	6 / 46	0.008	530	12.7879	0.62	ND		Yes	
Phenanthrene	0.35 :	37	22 / 46	0.011	1000	22.8386	0.405	0.043	0.043	Yes	
Phenol	0.33 :	160	3 / 46	0.047	2.4	3.0598	0.645	ND		Yes	
Pyrene	0.39 :	37	25 / 46	0.011	320	8.0466	0.39	0.056	0.065	Yes	
bis(2-EthylHexyl)phthalate	0.43 :	160	41 / 46	0.0655	5500	130.4144	0.82	ND		Yes	
Pesticides/PCBs (mg/Kg)											
4,4'-DDD	0.0035 :	0.1	14 / 47	0.0001	0.039	0.0097	0.0056	NB		Yes	
4,4'-DDE	0.0035 :	0.1	20 / 47	0.0005	0.049	0.0098	0.0042	NB		Yes	
4,4'-DDT	0.0038 :	0.1	27 / 47	0.0014	1.7	0.0623	0.0066	NB		Yes	
Aldrin	0.0018 :	0.17	7 / 47	0.0001	0.003	0.0054	0.0026	NB		Yes	
Alpha-BHC	0.0018 :	0.17	7 / 47	0.0002	0.22	0.0098	0.0031	NB		Yes	
Alpha-Chlordane	0.0018 :	0.27	8 / 47	0.0002	0.052	0.0297	0.0034	NB		Yes	
Beta-BHC	0.0018 :	0.17	1 / 47	0.0001	0.0001	0.0055	0.003	NB		No	FC
Delta-BHC	0.0018 :	0.17	1 / 47	0.0015	0.0015	0.0055	0.0029	NB		No	FC
Dieldrin	0.0035 :	0.68	13 / 47	0.0004	0.012	0.0159	0.006	NB		Yes	
Endosulfan I	0.0018 :	0.17	5 / 47	0.0019	0.099	0.0077	0.0032	NB		Yes	
Endosulfan II	0.0035 :	0.1	2 / 47	0.092	0.34	0.0175	0.0058	NB		Yes	
Endrin	0.0035 :	0.1	2 / 47	0.0004	0.0072	0.0092	0.0058	NB		Yes	
Endrin Aldehyde	0.0035 :	0.17	1 / 47	0.0006	0.0006	0.0079	0.0058	NB		No	FC
Endrin Ketone	0.0035 :	0.065	3 / 47	0.0014	0.0048	0.0083	0.0056	NB		Yes	
Gamma-BHC (Lindane)	0.002 :	0.17	17 / 47	0.0001	0.17	0.0145	0.0034	NB		Yes	
Gamma-Chlordane	0.0018 :	0.26	5 / 47	0.0003	0.0088	0.0242	0.0032	NB		Yes	
Heptachlor	0.0018 :	0.52	3 / 47	0.0003	0.0009	0.0149	0.0027	NB		Yes	
Heptachlor Epoxide	0.0018 :	0.17	4 / 47	0.0001	0.0028	0.0055	0.003	NB		Yes	
PCB-1016	0.16 :	0.27	1 / 13	0.98	0.98	0.1737	0.22	NB		Yes	
Metals (mg/Kg)											
Aluminum	0 :	0	34 / 34	1700	59000	6836.618	4825	NA	13000	Yes	
Antimony	0.97 :	22	10 / 34	1	79	9.8671	1.3	NA	1.4	Yes	
Arsenic	0.9 :	1.6	32 / 34	1.2	30.9	8.625	6.9	NA	17	Yes	
Barium	0 :	0	34 / 34	3.6	47	18.2059	18	NA	45	Yes	
Beryllium	0.18 :	1.6	6 / 34	0.2	4	0.5032	0.3	NA	0.4	Yes	
Cadmium	0.18 :	1.1	2 / 34	1.3	5.8	0.454	0.265	NA	2	Yes	
Calcium	0 :	0	34 / 34	61.1	53000	3050.709	695	620	2000	Yes	
Chromium	0 :	0	48 / 48	2.6	5000	419.4927	27	NA	29	Yes	
Cobalt	0.21 :	1.5	31 / 34	0.42	45	3.7466	1.85	NA	4.4	Yes	

TABLE 1
IDENTIFICATION OF HUMAN HEALTH OHM OF CONCERN - SURFACE SOIL

Olin Corporation
Wilmington, MA Facility

OHM	Site Data/Concentration [1] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Median	Background Concentration [2] Median	Maximum	OHM of Concern? [3]	Reason [4]
Copper	0 :	0	34 / 34	1.1	35	10.5809	6.8	NA	38	No	B
Cyanide	2 :	2	2 / 13	5.2	7.5	1.8231	2	ND		Yes	
Iron	0 :	0	34 / 34	1200	100000	9947.647	6700	NA	17000	Yes	
Lead	10 :	10	33 / 34	2	210	34.8162	17.8	NA	99	Yes	
Magnesium	0 :	0	34 / 34	16.4	4880	1074.762	887	NA	4900	No	B
Manganese	0 :	0	34 / 34	1.7	530	76.2441	48.25	NA	300	Yes	
Mercury	0.089 :	0.18	16 / 34	0.01	3.2	0.278	0.12	NA	0.3	Yes	
Nickel	0 :	0	34 / 34	0.96	67	8.4282	5.6	NA	17	Yes	
Potassium	0 :	0	34 / 34	46.3	1840	380.8147	240	260	1400	No	B
Selenium	0.5 :	5.1	14 / 34	0.51	2.2	0.7712	0.97	NA	0.5	Yes	
Sodium	0 :	0	34 / 34	32	680	103.5294	71.8	29	130	Yes	
Thallium	0.5 :	2.3	9 / 34	0.63	1.85	0.8165	1.5	NA	0.6	Yes	
Vanadium	0 :	0	34 / 34	4.3	37	15.1618	15	NA	29	Yes	
Zinc	0 :	0	34 / 34	4.8	180	35.4941	29.05	NA	116	Yes	
Inorganics (mg/Kg)											
Chloride	40 :	40	7 / 14	49	560	92.4643	44.5	NB	NB	Yes	
Nitrogen, Ammonia	0 :	0	39 / 40	14	670	135.1863	77.7	26	37	Yes	
Sulfate as SO4	40 :	430	34 / 40	4.2	28000	4115.608	270	< 40	30	Yes	

Notes:
1 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the reporting limit used as the value for non-detects.
The median represents the median value of all sample results, including non-detects, with the reporting limit used as the value for non-detects.
2 The background data set is presented in Section 4.1 of the Phase II Report and in Attachment 2.
For OHM with site-specific background data, the maximum detected concentration in the background data set and the median concentration are reported.
The median concentration represents the median of all samples in the background data set, with the reporting limit used as the value for non-detects.
For OHM without site-specific background data, the MADEP Background Soil Concentration is reported as the maximum background concentration (MADEP, 1995)
3 OHM of Concern are OHM that are inconsistent with background conditions and not detected at a low frequency and low concentration.
4 Reason for exclusion as OHM of Concern:
B = Background; the concentration of OHM in the site data is consistent with the concentration of OHM in the background data, as determined by the following criteria (MADEP, 1995):
(1) For OHM without site-specific background data, the maximum detected site concentration is less than or equal to the MADEP background soil concentration.
(2) For OHM with site-specific background data: (a) the maximum detected site concentration is less than or equal to the maximum site-specific background concentration, and the median site concentration is not more than 50% greater than the median site-specific background concentration; (b) the median site concentration is less than or equal to the median site-specific background concentration and the maximum detected site concentration is not more than 50% greater than the maximum site-specific background concentration; (c) both the maximum and median site concentrations are equal to or less than the maximum and median site-specific background concentrations, respectively.
FC = Low Frequency and Concentration; the OHM was not detected in more than two samples and the detected concentration was not more than two times the minimum SQL.
OHM = Oil or Hazardous Material

TABLE 1
IDENTIFICATION OF HUMAN HEALTH OHM OF CONCERN - SURFACE SOIL

Olin Corporation
Wilmington, MA Facility

OHM	Site Data/Concentration [1]							Background Concentration [2]		OHM of Concern? [3]	Reason [4]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Median	Median	Maximum		

SQL = Sample Quantitation Limit
NB = Not judged to be a background analyte (see background discussion).
ND = Not detected in background data set.
NA = Not Available/Not Applicable
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 2
IDENTIFICATION OF HUMAN HEALTH OHM OF CONCERN - SUBSURFACE SOIL

Olin Corporation
Wilmington, MA Facility

OHM	Site Data/Concentration [1]							Background Concentration [2]		OHM of Concern? [3]	Reason [4]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Median	Median	Maximum		
VOCs (mg/Kg)											
1,2-Dichloroethane	0.0007 :	0.7	3 / 57	0.002	0.082	0.0318	0.0055	NB		Yes	
2,4,4-Trimethyl-1-pentene	0.01 :	1	40 / 50	0.002	360	14.7849	0.0285	NB		Yes	
2,4,4-Trimethyl-2-pentene	0.01 :	1	36 / 50	0.001	210	6.5577	0.0155	NB		Yes	
2-Butanone (MEK)	0.002 :	2	21 / 57	0.0006	0.49	0.08	0.016	NB		Yes	
2-Hexanone	0.002 :	2	15 / 58	0.001	3.8	0.2227	0.0165	NB		Yes	
4-Methyl-2-Pentanone (MIBK)	0.002 :	2	6 / 57	0.005	3	0.1473	0.016	NB		Yes	
Acetone	0.002 :	2	17 / 57	0.016	690	12.6664	0.018	NB		Yes	
Benzene	0.0007 :	0.9	7 / 57	0.0005	3.8	0.0932	0.0055	NB		Yes	
Carbon Disulfide	0.0013 :	1.3	5 / 57	0.001	3.4	0.1083	0.011	NB		Yes	
Carbon Tetrachloride	0.0007 :	0.9	2 / 57	0.003	0.009	0.0378	0.0055	NB		Yes	
Chlorobenzene	0.0007 :	0.9	5 / 57	0.017	0.86	0.0561	0.0055	NB		Yes	
Chloroform	0.0007 :	0.9	4 / 57	0.001	0.007	0.0377	0.0055	NB		Yes	
Chloromethane (Methyl Chloride)	0.0013 :	2	1 / 57	0.0004	0.0004	0.0661	0.011	NB		No	FC
Ethylbenzene	0.0007 :	0.7	12 / 58	0.0019	2.3	0.0934	0.0055	NB		Yes	
Methylene Chloride	0.0013 :	2	7 / 57	0.002	2	0.0967	0.011	NB		Yes	
Styrene	0.0007 :	0.9	9 / 57	0.0005	3.3	0.0973	0.0055	NB		Yes	
Tetrachloroethene (PCE)	0.0007 :	0.9	10 / 58	0.0008	0.023	0.0371	0.0055	NB		Yes	
Toluene	0.0007 :	0.028	36 / 57	0.0003	13	0.4144	0.0055	NB		Yes	
Trichloroethene (TCE)	0.0007 :	0.9	3 / 56	0.01	0.08	0.0275	0.0055	NB		Yes	
Xylenes, Total	0.0007 :	0.7	11 / 57	0.0011	1.7	0.0849	0.0055	NB		Yes	
SVOCs (mg/Kg)											
1,2,3-Trichlorobenzene	0.4 :	10	1 / 4	1.4	1.4	2.025	2.2	ND		Yes	
1,2,4-Trichlorobenzene	0.012 :	1.2	4 / 50	0.075	1.8	0.3794	0.73	ND		Yes	
1,2-Dichlorobenzene	0.012 :	12	3 / 54	0.17	4.7	0.6806	0.73	ND		Yes	
1,3-Dichlorobenzene	0.012 :	12	1 / 54	0.29	0.29	0.6572	0.73	ND		Yes	
1,4-Dichlorobenzene	0.012 :	12	3 / 54	0.23	5.6	0.7076	0.73	ND		Yes	
2,4-Dimethylphenol	0.012 :	12	1 / 54	3.5	3.5	0.6292	0.73	ND		Yes	
2-Methylnaphthalene	0.012 :	12	1 / 54	0.063	0.063	0.6514	0.73	ND		Yes	
2-Methylphenol (o-Cresol)	0.012 :	12	1 / 54	8	8	0.7125	0.73	ND		Yes	
4-Bromophenyl-phenylether	0.4 :	10	1 / 8	1.1	1.1	1.7038	0.965	ND		Yes	
4-Chlorophenyl-phenylether	0.012 :	12	2 / 54	0.17	2.2	0.688	0.73	ND		Yes	
4-Methylphenol(p-Cresol)	0.012 :	12	2 / 54	0.038	3.6	0.628	0.73	ND		Yes	
Anthracene	0.012 :	12	1 / 54	0.028	0.028	0.6511	0.73	ND		Yes	
Benzo(a)Anthracene	0.012 :	12	4 / 54	0.048	0.08	0.6343	0.73	ND		Yes	
Benzo(a)Pyrene	0.012 :	12	1 / 54	0.055	0.055	0.6516	0.73	ND		Yes	
Benzo(b)Fluoranthene	0.012 :	12	5 / 54	0.039	0.084	0.628	0.73	0.06	0.062	Yes	

TABLE 2
IDENTIFICATION OF HUMAN HEALTH OHM OF CONCERN - SUBSURFACE SOIL

Olin Corporation
Wilmington, MA Facility

OHM	Site Data/Concentration [1] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Median	Background Concentration [2] Median	Maximum	OHM of Concern? [3]	Reason [4]
Butylbenzylphthalate	0.012 :	12	11 / 54	0.035	4.5	0.7558	0.73	ND		Yes	
Chrysene	0.012 :	12	4 / 54	0.057	0.089	0.6355	0.73	ND		Yes	
Di-n-butylphthalate	0.012 :	12	6 / 54	0.032	32	1.4269	0.73	ND		Yes	
Di-n-octylphthalate	0.012 :	12	20 / 55	0.014	0.88	0.5912	0.69	ND		Yes	
Dibenzofuran	0.012 :	12	4 / 54	0.095	1.4	0.585	0.73	ND		Yes	
Diethylphthalate	0.012 :	12	2 / 54	0.046	0.057	0.644	0.73	ND		Yes	
Fluoranthene	0.012 :	12	4 / 54	0.038	0.16	0.6351	0.73	0.057	0.066	Yes	
Hexachlorobenzene	0.012 :	12	1 / 54	0.24	0.24	0.6562	0.73	ND		Yes	
Indeno (1,2,3-cd)Pyrene	0.012 :	12	3 / 55	0.28	31	1.1337	0.73	ND		Yes	
Isophorone	0.012 :	12	2 / 54	0.9	2.1	0.6162	0.73	ND		Yes	
N-Nitroso-di-n-propylamine	0.33 :	12	1 / 54	1.6	1.6	0.6865	0.73	ND		Yes	
N-Nitrosodiphenylamine	0.012 :	12	22 / 54	0.15	21000	691.857	0.76	ND		Yes	
Naphthalene	0.012 :	12	6 / 54	0.077	4.1	0.6407	0.73	ND		Yes	
Phenanthrene	0.012 :	12	6 / 54	0.052	0.69	0.6507	0.73	0.043	0.043	Yes	
Phenol	0.33 :	12	9 / 54	0.055	510	10.0864	0.73	ND		Yes	
Pyrene	0.012 :	12	10 / 54	0.043	0.2	0.6102	0.73	0.056	0.065	Yes	
bis(2-EthylHexyl)phthalate	0.012 :	2.5	40 / 57	0.1	6700	250.5573	1.8	ND		Yes	
Pesticides/PCBs (mg/Kg)											
4,4'-DDD	0.0001 :	1.2	1 / 50	0.04	0.04	0.0422	0.035	NB		Yes	
Aldrin	0.0001 :	0.61	1 / 50	0.032	0.032	0.0215	0.018	NB		Yes	
Alpha-BHC	0.0001 :	0.61	1 / 50	0.024	0.024	0.0213	0.018	NB		Yes	
Alpha-Chlordane	0.0005 :	6.1	1 / 50	2	2	0.2299	0.18	NB		Yes	
Endosulfan I	0.0001 :	0.61	1 / 50	0.036	0.036	0.0215	0.018	NB		Yes	
Endosulfan Sulfate	0.0001 :	1.2	1 / 50	0.15	0.15	0.0444	0.035	NB		Yes	
Endrin	0.0001 :	1.2	1 / 50	0.089	0.089	0.0432	0.035	NB		Yes	
Endrin Ketone	0.0001 :	1.2	1 / 50	0.045	0.045	0.0423	0.035	NB		Yes	
Gamma-BHC (Lindane)	0.0001 :	0.61	1 / 50	0.048	0.048	0.0218	0.018	NB		Yes	
Methoxychlor	0.0005 :	6.1	1 / 50	2	2	0.2299	0.18	NB		Yes	
Toxaphene	0.001 :	12	1 / 50	4	4	0.4579	0.35	NB		Yes	
Metals (mg/Kg)											
Aluminum	0 :	0	56 / 56	0.82	10000	4669.295	4650	NA	13000	No	B
Antimony	0.02 :	20	1 / 53	41	41	8.5303	20	NA	1.4	Yes	
Arsenic	0.0015 :	2.9	51 / 55	0.0017	21	5.2468	4.2	NA	17	Yes	
Barium	0.0005 :	0.0005	54 / 55	0.0036	75	17.1333	13	NA	45	Yes	
Cadmium	0.001 :	1.1	16 / 54	0.004	5.1	0.6993	1	NA	2	Yes	
Calcium	0 :	0	56 / 56	0.11	61000	2891.763	750	620	2000	Yes	
Chromium	0 :	0	56 / 56	0.0066	17000	477.0778	21	NA	29	Yes	

TABLE 2
IDENTIFICATION OF HUMAN HEALTH OHM OF CONCERN - SUBSURFACE SOIL

Olin Corporation
Wilmington, MA Facility

OHM	Site Data/Concentration [1]							Background Concentration [2]		OHM of Concern? [3]	Reason [4]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Median	Median	Maximum		
Cobalt	0.0015	3	39 / 55	0.0016	8.7	2.3366	2.4	NA	4.4	Yes	
Copper	2.5	2.5	51 / 56	0.0028	57	8.2232	5	NA	38	Yes	
Cyanide	0.002	2	3 / 45	2.3	5.4	1.0002	2	ND		Yes	
Iron	0	0	56 / 56	0.21	94000	7838.897	5750	NA	17000	Yes	
Lead	0.01	10	14 / 52	0.011	52	8.3972	10	NA	99	No	B
Magnesium	0.005	0.005	54 / 55	0.0066	4700	1587.349	1100	NA	4900	No	B
Manganese	0	0	56 / 56	0.0034	460	81.1734	59.5	NA	300	Yes	
Mercury	0.0001	0.15	8 / 53	0.0001	0.52	0.0605	0.1	NA	0.3	Yes	
Nickel	0.004	4	44 / 54	0.0046	30	6.9643	5.45	NA	17	Yes	
Potassium	0	0	56 / 56	0.0035	2100	690.8715	475	260	1400	Yes	
Silver	0.0015	1.7	1 / 53	4.5	4.5	0.7237	1.5	NA	0.6	Yes	
Sodium	0	0	56 / 56	0.023	8600	248.6442	80.5	29	130	Yes	
Vanadium	0.0025	2.5	51 / 56	0.007	35	10.0848	8.5	NA	29	Yes	
Zinc	2.5	2.5	55 / 56	0.018	100	22.8185	18	NA	116	No	B
Inorganics (mg/Kg)											
Nitrate as N	0	0	2 / 2	14	24	19	19	NB		Yes	
Chloride	0.04	40	22 / 49	0.26	170	37.1584	40	NB		Yes	
Nitrogen, Ammonia	8	8	43 / 50	0.02	10000	257.8453	25	26	37	Yes	
Sulfate as SO4	20	80	37 / 50	22	33000	2552.67	82.5	< 40	30	Yes	

Notes:

1 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the reporting limit used as the value for non-detects.
The median represents the median value of all sample results, including non-detects, with the reporting limit used as the value for non-detects.

2 The background data set is presented in Section 4.1 of the Phase II Report and in Attachment 2.
For OHM with site-specific background data, the maximum detected concentration in the background data set and the median concentration are reported.
The median concentration represents the median of all samples in the background data set, with the reporting limit used as the value for non-detects.
For OHM without site-specific background data, the MADEP Background Soil Concentration is reported as the maximum background concentration (MADEP, 1995)

3 OHM of Concern are OHM that are inconsistent with background conditions and not detected at a low frequency and low concentration.

4 Reason for exclusion as OHM of Concern:
B = Background; the concentration of OHM in the site data is consistent with the concentration of OHM in the background data, as determined by the following criteria (MADEP, 1995):
(1) For OHM without site-specific background data, the maximum detected site concentration is less than or equal to the MADEP background soil concentration.
(2) For OHM with site-specific background data: (a) the maximum detected site concentration is less than or equal to the maximum site-specific background concentration, and the median site concentration is not more than 50% greater than the median site-specific background concentration; (b) the median site concentration is less than or equal to the median site-specific background concentration and the maximum detected site concentration is not more than 50% greater than the maximum site-specific background concentration; (c) both the maximum and median site concentrations are equal to or less than

TABLE 2
IDENTIFICATION OF HUMAN HEALTH OHM OF CONCERN - SUBSURFACE SOIL

Olin Corporation
Wilmington, MA Facility

OHM	Site Data/Concentration [1]							Background Concentration [2]		OHM of Concern? [3]	Reason [4]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Median	Median	Maximum		

the maximum and median site-specific background concentrations, respectively.

FC = Low Frequency and Concentration; the OHM was not detected in more than two samples and the detected concentration was not more than two times the minimum SQL.

OHM = Oil or Hazardous Material

SQL = Sample Quantitation Limit

NB = Not judged to be a background analyte (see background discussion).

ND = Not detected in background data set.

NA = Not Available/Not Applicable

MADEP (1995): *Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan* (WSC/ORS-95-141, July).

TABLE 3
IDENTIFICATION OF HUMAN HEALTH OHM OF CONCERN - NON-ZONE II GROUNDWATER

Olin Corporation
Wilmington, MA Facility

OHM	Site Data/Concentration [1]							Background Concentration [2]		OHM of Concern? [3]	Reason [4]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Median	Median	Maximum		
VOCs (mg/L)											
1,1,1-Trichloroethane	0.005 :	0.05	10 / 76	0.001	0.019	0.003532895	0.005	NB		Yes	
1,1,2-Trichloroethane	0.005 :	0.05	1 / 76	0.002	0.002	0.003019737	0.005	NB		No	FC
1,1-Dichloroethane	0.005 :	0.3	9 / 76	0.0008	0.006	0.005030263	0.005	NB		Yes	
1,1-Dichloroethene	0.005 :	0.3	4 / 77	0.001	0.003	0.004876623	0.005	NB		Yes	
1,2-Dichloroethane	0.005 :	0.05	15 / 76	0.002	0.027	0.004835526	0.005	NB		Yes	
1,2-Dichloropropane	0.005 :	0.05	1 / 74	0.001	0.001	0.00302027	0.005	NB		No	FC
2,4,4-Trimethyl-1-pentene	0.005 :	0.1	31 / 83	0.002	3.5	0.076536145	0.01	NB		Yes	
2,4,4-Trimethyl-2-Pentene	0.005 :	0.1	24 / 85	0.0007	1.2	0.02966	0.01	NB		Yes	
2-Butanone (MEK)	0.01 :	0.2	4 / 75	0.003	0.052	0.00946	0.015	NB		Yes	
2-Hexanone	0.01 :	0.2	3 / 76	0.009	0.16	0.012947368	0.015	NB		Yes	
4-Methyl-2-Pentanone (MIBK)	0.01 :	0.2	3 / 76	0.001	0.004	0.008664474	0.015	NB		Yes	
Acetone	0.01 :	0.3	39 / 76	0.001	13	0.355263158	0.015	NB		Yes	
Benzene	0.005 :	0.05	5 / 77	0.002	0.004	0.003019481	0.005	NB		Yes	
Bromodichloromethane	0.005 :	0.05	12 / 76	0.002	0.043	0.005276316	0.005	NB		Yes	
Bromoform	0.005 :	0.01	20 / 76	0.002	0.75	0.037440789	0.005	NB		Yes	
Carbon Disulfide	0.005 :	0.1	16 / 76	0.003	0.051	0.007736842	0.01	NB		Yes	
Carbon Tetrachloride	0.005 :	0.05	6 / 75	0.001	0.016	0.003333333	0.005	NB		Yes	
Chlorobenzene	0.005 :	0.05	2 / 76	0.001	0.001	0.002986842	0.005	NB		No	FC
Chloroform	0.005 :	0.01	16 / 76	0.002	0.094	0.008703947	0.005	NB		Yes	
Chloromethane (Methyl Chloride)	0.01 :	0.1	6 / 71	0.001	0.006	0.005830986	0.01	NB		Yes	
Dibromochloromethane	0.005 :	0.05	15 / 76	0.002	0.17	0.011296053	0.005	NB		Yes	
Ethylbenzene	0.005 :	0.05	5 / 76	0.001	0.006	0.003032895	0.005	NB		Yes	
Methylene Chloride	0.002 :	0.1	15 / 75	0.0008	0.013	0.005590667	0.01	NB		Yes	
Tetrachloroethene (PCE)	0.002 :	0.05	5 / 76	0.001	0.078	0.003934211	0.005	NB		Yes	
Toluene	0.005 :	0.01	17 / 76	0.001	0.081	0.009657895	0.005	NB		Yes	
Trichloroethene (TCE)	0.005 :	0.05	12 / 76	0.002	0.016	0.003144737	0.005	NB		Yes	
Xylenes, Total	0.005 :	0.05	4 / 76	0.001	0.007	0.003092105	0.005	NB		Yes	
SVOCs (mg/L)											
1,2,4-Trichlorobenzene	0.01 :	0.012	5 / 69	0.001	0.007	0.004898551	0.01	NB		Yes	
1,2-Dichlorobenzene	0.01 :	0.012	4 / 69	0.001	0.003	0.004855072	0.01	NB		Yes	
1,3-Dichlorobenzene	0.01 :	0.012	3 / 68	0.001	0.001	0.004838235	0.01	NB		Yes	
1,4-Dichlorobenzene	0.01 :	0.012	4 / 70	0.001	0.003	0.004871429	0.01	NB		Yes	
2,4,6-Trichlorophenol	0.01 :	0.012	1 / 69	0.001	0.001	0.004956522	0.01	NB		No	FC
2,4-Dichlorophenol	0.01 :	0.012	5 / 68	0.001	0.003	0.004764706	0.01	NB		Yes	
2,4-Dimethylphenol	0.01 :	0.012	1 / 69	0.004	0.004	0.005	0.01	NB		No	FC
2,6-Dinitrotoluene	0.01 :	0.012	4 / 70	0.001	0.005	0.004871429	0.01	NB		Yes	
2-Chlorophenol	0.01 :	0.012	6 / 68	0.001	0.003	0.004720588	0.01	NB		Yes	
2-Methylphenol (o-Cresol)	0.01 :	0.012	9 / 69	0.002	0.02	0.005115942	0.01	NB		Yes	
2-Nitrophenol	0.01 :	0.012	17 / 70	0.001	0.21	0.021714286	0.01	NB		Yes	

TABLE 3
IDENTIFICATION OF HUMAN HEALTH OHM OF CONCERN - NON-ZONE II GROUNDWATER

Olin Corporation
Wilmington, MA Facility

OHM	Site Data/Concentration [1] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Median	Background Concentration [2] Median	Maximum	OHM of Concern? [3]	Reason [4]
4-Bromophenyl-phenylether	0.01	0.012	10 / 69	0.001	0.044	0.005956522	0.01	NB		Yes	
4-Chloro-3-methylphenol	0.01	0.012	1 / 70	0.006	0.006	0.005028571	0.01	NB		No	FC
4-Chloroaniline	0.01	0.012	1 / 69	0.002	0.002	0.004971014	0.01	NB		No	FC
4-Chlorophenyl-phenylether	0.01	0.012	6 / 68	0.001	0.015	0.005014706	0.01	NB		Yes	
4-Methylphenol(p-Cresol)	0.01	0.012	11 / 69	0.002	0.081	0.008	0.01	NB		Yes	
4-Nitroaniline	0.01	0.06	2 / 70	0.002	0.003	0.012535714	0.025	NB		No	FC
4-Nitrophenol	0.025	0.06	22 / 69	0.001	0.33	0.037195652	0.025	NB		Yes	
Benzoic Acid	0.05	0.06	13 / 69	0.001	0.043	0.022507246	0.05	NB		Yes	
Benzyl Alcohol	0.01	0.012	9 / 70	0.002	0.009	0.004928571	0.01	NB		Yes	
Di-n-butylphthalate	0.01	0.012	8 / 74	0.0002	0.009	0.004668919	0.01	NB		Yes	
Dibenzofuran	0.01	0.012	4 / 68	0.001	0.002	0.004808824	0.01	NB		Yes	
Diethylphthalate	0.002	0.012	4 / 76	0.0003	0.0005	0.004717105	0.01	NB		Yes	
Isophorone	0.01	0.012	5 / 68	0.002	0.008	0.004941176	0.01	NB		Yes	
N-Nitrosodiphenylamine (1)	0.01	0.012	28 / 75	0.001	0.67	0.034013333	0.01	NB		Yes	
Naphthalene	0.01	0.012	17 / 68	0.0002	0.088	0.009988235	0.01	NB		Yes	
Phenol	0.01	0.012	23 / 69	0.002	1.2	0.097014493	0.01	NB		Yes	
bis(2-EthylHexyl)phthalate	0.01	0.014	19 / 74	0.0004	0.029	0.005066216	0.01	NB		Yes	
Pesticides/PCBs (mg/L)											
4,4'-DDD	0.0001	0.001	1 / 68	0.0001	0.0001	0.00008014	0.0001	NB		No	FC
4,4'-DDT	0.0001	0.001	2 / 68	0.000022	0.0001	0.00007974	0.0001	NB		No	FC
Aldrin	0.00005	0.0005	2 / 68	0.000012	0.000065	0.00004047	0.00005	NB		No	FC
Alpha-BHC	0.00005	0.0005	12 / 68	0.00005	0.0003	0.00005775	0.00005	NB		Yes	
Beta-BHC	0.00005	0.0005	5 / 68	0.000059	0.00012	0.00004409	0.00005	NB		Yes	
Delta-BHC	0.00005	0.0005	6 / 68	0.00005	0.0027	0.00008046	0.00005	NB		Yes	
Endosulfan I	0.00005	0.0005	2 / 68	0.000052	0.000054	0.0000409	0.00005	NB		No	FC
Endosulfan Sulfate	0.0001	0.001	1 / 68	0.00011	0.00011	0.00008029	0.0001	NB		No	FC
Endrin Aldehyde	0.0001	0.001	1 / 65	0.000097	0.000097	0.00006765	0.0001	NB		No	FC
Endrin Ketone	0.0001	0.001	1 / 68	0.000022	0.000022	0.000079	0.0001	NB		No	FC
Gamma-BHC (Lindane)	0.00005	0.0005	5 / 67	0.000003	0.00011	0.00004254	0.00005	NB		Yes	
Heptachlor	0.00005	0.0005	1 / 68	0.00005	0.00005	0.00004044	0.00005	NB		No	FC
Heptachlor Epoxide	0.00005	0.0005	6 / 68	0.000051	0.00022	0.00004544	0.00005	NB		Yes	
Metals (mg/L)											
Aluminum	0.1	0.1	7 / 11	0.68	2400	472.3527273	12	0.12	0.14	Yes	
Arsenic	0.005	10	1 / 11	0.01	0.01	0.640681818	0.01	ND		No	FC
Barium	0.05	0.1	8 / 11	0.016	0.19	0.062545455	0.05	0.025	0.026	Yes	
Beryllium	0.015	0.015	1 / 3	0.084	0.084	0.033	0.015	ND		Yes	
Cadmium	0.01	0.01	2 / 3	0.022	0.19	0.072333333	0.022	ND		Yes	
Calcium	NA		11 / 11	12	590	266	290	29	96	Yes	
Chromium	0.015	0.015	29 / 59	0.018	2800	152.8915424	0.015	ND		Yes	
Cobalt	NA		3 / 3	0.021	3	1.113666667	0.32	ND		Yes	

TABLE 3
IDENTIFICATION OF HUMAN HEALTH OHM OF CONCERN - NON-ZONE II GROUNDWATER

Olin Corporation
Wilmington, MA Facility

OHM	Site Data/Concentration [1] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Median	Background Concentration [2] Median	Maximum	OHM of Concern? [3]	Reason [4]
Copper	NA		3 / 3	0.13	2.8	1.096666667	0.36	0.025	0.133	Yes	
Cyanide	0.02	0.02	2 / 3	0.026	0.053	0.029666667	0.026	ND		Yes	
Hexavalent Chromium	0.015	0.015	1 / 8	0.035	0.035	0.0109375	0.015	ND		Yes	
Iron	0.025	0.24	7 / 11	0.38	3600	660.1483636	21	0.088	6.6	Yes	
Lead	0.005	0.25	2 / 11	0.087	0.17	0.042909091	0.005	0.005	0.009	Yes	
Magnesium	NA		11 / 11	1.1	1600	323.0909091	84	4.8	10	Yes	
Manganese	NA		11 / 11	0.061	580	95.10463636	10	0.16	0.97	Yes	
Mercury	0.0002	0.0002	1 / 3	0.0009	0.0009	0.000366667	0.0002	ND		Yes	
Nickel	NA		3 / 3	0.11	4.2	1.5	0.19	ND		Yes	
Potassium	NA		11 / 11	1.2	110	30.24545455	16	2.6	3.3	Yes	
Sodium	NA		11 / 11	19	22000	5096.090909	1200	33.8	175	Yes	
Trivalent Chromium	0.015	0.015	4 / 8	0.019	0.22	0.04075	0.017	ND		Yes	
Vanadium	0.025	0.025	2 / 3	0.1	1.4	0.504166667	0.1	ND		Yes	
Zinc	NA		3 / 3	0.065	14	4.768333333	0.24	0.025	0.182	Yes	
Opex and Kempore (mg/L)	3.6	3.6		3.8	3.8	1.97	3.6				
Kempore (Azodicarbonamide)	0.0036	0.0036	1 / 12	0.0038	0.0038	0.001966667	0.0036	NB		No	FC
Inorganics (mg/L)											
Chloride	3	3	150 / 151	2.8	91000	2846.582119	100	75	235	Yes	
Nitrate as N	0.14	0.32	8 / 10	0.42	22	7.797	3.75	0.52	6.1	Yes	
Nitrite as N	0.05	0.05	3 / 9	0.17	0.33	0.092222222	0.05	0.005	0.012	Yes	
Nitrogen, Ammonia	0.04	0.1	155 / 162	0.23	7000	395.5887654	40.8	0.1	0.54	Yes	
Sulfate as SO4	240	240	153 / 154	5.8	87000	8777.408442	630	20	55	Yes	

Notes:
1 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the reporting limit used as the value for non-detects.
The median represents the median value of all sample results, including non-detects, with the reporting limit used as the value for non-detects.
2 The background data set is presented in Section 4.1 of the Phase II Report and in Attachment 2.
For OHM with site-specific background data, the maximum detected concentration in the background data set and the median concentration are reported.
The median concentration represents the median of all samples in the background data set, with the reporting limit used as the value for non-detects.
3 OHM of Concern are OHM that are inconsistent with background conditions and not detected at a low frequency and low concentration.
For evaluation of shallow groundwater, only volatiles are identified as OHM of Concern.
4 Reason for exclusion as OHM of Concern:
B = Background; the concentration of OHM in the site data is consistent with the concentration of OHM in the background data, as determined by the following criteria (MADEP, 1995):
For OHM with site-specific background data: (a) the maximum detected site concentration is less than or equal to the maximum site-specific background concentration, and the median site concentration is not more than 50% greater than the median site-specific background concentration; (b) the median site concentration is less than or equal to the median site-specific background concentration and the maximum detected site concentration is not more than 50% greater than the maximum site-specific background concentration; (c) both the maximum and median site concentrations are equal to or less than the maximum and median site-specific background concentrations, respectively.

TABLE 3
IDENTIFICATION OF HUMAN HEALTH OHM OF CONCERN - NON-ZONE II GROUNDWATER

Olin Corporation
Wilmington, MA Facility

	Site Data/Concentration [1]							Background Concentration [2]			
OHM	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Median	Median	Maximum	OHM of Concern? [3]	Reason [4]

FC = Low Frequency and Concentration; the OHM was not detected in more than two samples and the maximum detected concentration was not more than two times the minimum SQL.
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
NB = Not judged to be a background analyte (see background discussion).
ND = Not detected in background data set.
NA = Not Available/Not Applicable
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 4
IDENTIFICATION OF HUMAN HEALTH OHM OF CONCERN - ZONE II GROUNDWATER

Olin Corporation
Wilmington, MA Facility

OHM	Site Data/Concentration [1]							Background Concentration [2]		OHM of Concern? [3]	Reason [4]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Median	Median	Maximum		
VOCs (mg/L)											
1,1,1-Trichloroethane	0.005	0.02	1 / 33	0.0003	0.0003	0.0029	0.005	NB		No	FC
1,1-Dichloroethane	0.0002	0.02	1 / 35	0.0002	0.0002	0.0029	0.005	NB		No	FC
1,2-Dichloroethane	0.0002	0.02	8 / 35	0.0001	0.02	0.0035	0.005	NB		Yes	
1,2-Dichloroethene(total)	0.005	0.005	11 / 33	0.002	0.43	0.0366	0.005	NB		Yes	
2,4,4-Trimethyl-1-pentene	0.005	0.02	7 / 34	0.002	0.012	0.005	0.01	NB		Yes	
2,4,4-Trimethyl-2-Pentene	0.005	0.02	5 / 34	0.002	0.006	0.0044	0.01	NB		Yes	
2-Butanone (MEK)	0.01	0.04	2 / 33	0.011	0.027	0.0083	0.015	NB		Yes	
2-Hexanone	0.01	0.015	3 / 33	0.057	0.12	0.0148	0.015	NB		Yes	
4-Methyl-2-Pentanone (MIBK)	0.01	0.04	3 / 33	0.003	0.003	0.0072	0.015	NB		Yes	
Acetone	0.01	0.04	9 / 33	0.004	0.37	0.0288	0.015	NB		Yes	
Benzene	0.0004	0.02	11 / 35	0.0001	0.011	0.003	0.005	NB		Yes	
Bromodichloromethane	0.0002	0.02	1 / 35	0.002	0.002	0.0029	0.005	NB		Yes	
Bromoform	0.005	0.02	2 / 33	0.004	0.014	0.0034	0.005	NB		Yes	
Carbon Disulfide	0.005	0.02	4 / 33	0.001	0.015	0.0051	0.01	NB		Yes	
Chlorobenzene	0.0002	0.02	3 / 35	0.0002	0.001	0.0028	0.005	NB		Yes	
Chloroform	0.0003	0.02	6 / 35	0.004	0.079	0.009	0.005	NB		Yes	
Chloromethane(MethylChloride)	0.01	0.04	2 / 33	0.001	0.007	0.006	0.01	NB		No	FC
Dibromochloromethane	0.0002	0.02	1 / 35	0.003	0.003	0.0029	0.005	NB		Yes	
Ethylbenzene	0.005	0.05	6 / 33	0.002	0.007	0.004	0.005	NB		Yes	
Methylene Chloride	0.005	0.033	10 / 35	0.0009	0.02	0.005	0.01	NB		Yes	
Tetrachloroethene (PCE)	0.0002	0.02	4 / 34	0.001	0.004	0.0028	0.005	NB		Yes	
Toluene	0.005	0.02	9 / 33	0.001	0.17	0.0219	0.005	NB		Yes	
Trichloroethene (TCE)	0.005	0.02	14 / 35	0.0009	0.46	0.0316	0.005	NB		Yes	
Vinyl Chloride	0.0004	0.04	3 / 35	0.0002	0.013	0.0059	0.01	NB		Yes	
Xylenes, Total	0.005	0.02	4 / 33	0.004	0.017	0.0039	0.005	NB		Yes	
cis-1,2-Dichloroethene	0	0	2 / 2	0.0052	0.033	0.0191	0.0191	NB		Yes	
trans-1,2-Dichloroethene	0.0002	0.0002	1 / 2	0.0003	0.0003	0.0002	0.0002	NB		Yes	
SVOCs (mg/L)											
1,2,4-Trichlorobenzene	0.01	0.01	2 / 32	0.0007	0.001	0.0047	0.01	NB		No	FC
1,2-Dichlorobenzene	0.01	0.01	3 / 32	0.0003	0.001	0.0046	0.01	NB		Yes	
1,3-Dichlorobenzene	0.01	0.01	1 / 34	0.003	0.003	0.0049	0.01	NB		No	FC
1,4-Dichlorobenzene	0.01	0.01	3 / 32	0.001	0.002	0.0047	0.01	NB		Yes	
2,4-Dichlorophenol	0.01	0.01	4 / 32	0.001	0.003	0.0046	0.01	NB		Yes	
2,4-Dimethylphenol	0.01	0.01	1 / 32	0.001	0.001	0.0049	0.01	NB		No	FC
2,6-Dinitrotoluene	0.01	0.01	1 / 32	0.0051	0.0051	0.005	0.01	NB		No	FC
2-Chlorophenol	0.01	0.01	2 / 32	0.001	0.001	0.0048	0.01	NB		No	FC

TABLE 4
IDENTIFICATION OF HUMAN HEALTH OHM OF CONCERN - ZONE II GROUNDWATER

Olin Corporation
Wilmington, MA Facility

	Site Data/Concentration [1]								Background Concentration [2]			
OHM	Minimum SQL		Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Median	Median	Maximum	OHM of Concern? [3]	Reason [4]
2-Methylnaphthalene	0.01	:	0.01	1 / 32	0.001	0.001	0.0049	0.01	NB		No	FC
2-Methylphenol (o-Cresol)	0.01	:	0.01	4 / 32	0.002	0.017	0.0054	0.01	NB		Yes	
2-Nitrophenol	0.01	:	0.01	2 / 32	0.032	0.045	0.0071	0.01	NB		Yes	
4-Methylphenol(p-Cresol)	0.01	:	0.01	4 / 32	0.002	0.051	0.0081	0.01	NB		Yes	
4-Nitrophenol	0.025	:	0.05	4 / 32	0.004	0.11	0.0216	0.025	NB		Yes	
Benzoic Acid	0.05	:	0.05	3 / 32	0.003	0.041	0.0249	0.05	NB		Yes	
Benzyl Alcohol	0.01	:	0.01	4 / 32	0.002	0.006	0.0048	0.01	NB		Yes	
Di-n-butylphthalate	0.01	:	0.01	12 / 33	0.0003	0.0009	0.0034	0.01	NB		Yes	
Di-n-octylphthalate	0.01	:	0.01	2 / 32	0.0003	0.001	0.0048	0.01	NB		No	FC
Diethylphthalate	0.007	:	0.01	8 / 35	0.0002	0.005	0.0041	0.01	NB		Yes	
Dimethylphthalate	0.01	:	0.01	1 / 33	0.0004	0.0004	0.0049	0.01	NB		No	FC
N-Nitrosodiphenylamine	0.01	:	0.01	4 / 33	0.001	0.011	0.005	0.01	NB		Yes	
Naphthalene	0.01	:	0.01	7 / 34	0.0002	0.015	0.005	0.01	NB		Yes	
Phenol	0.01	:	0.01	5 / 34	0.005	1.2	0.0674	0.01	NB		Yes	
Pyrene	0.01	:	0.01	1 / 32	0.0005	0.0005	0.0049	0.01	NB		No	FC
bis(2-EthylHexyl)phthalate	0.01	:	0.01	10 / 34	0.0002	0.012	0.0043	0.01	NB		Yes	
Pesticides/PCBs (mg/L)												
Alpha-BHC	0.00005	:	0.0005	3 / 20	5.9E-05	0.000073	4.53E-05	5E-05	NB		Yes	
Gamma-BHC (Lindane)	0.00005	:	0.0006	1 / 21	0.00011	0.00011	4.21E-05	5E-05	NB		Yes	
Heptachlor Epoxide	0.00005	:	0.0006	1 / 21	8.7E-05	0.000087	4.1E-05	5E-05	NB		No	FC
Metals (mg/L)												
Aluminum	0.1	:	0.1	3 / 8	0.63	990	127.985	0.1	0.12	0.14	Yes	
Arsenic	0.005	:	2.5	4 / 8	0.005	0.084	0.1706	0.0065	ND		Yes	
Barium	0.05	:	0.05	7 / 8	0.006	0.28	0.0513	0.0225	0.025	0.026	Yes	
Calcium	0	:	0	7 / 7	5.1	470	162.3	22	29	96	Yes	
Chromium	0.01	:	0.03	5 / 29	0.023	790	27.4238	0.01	ND		Yes	
Cobalt	0	:	0	1 / 1	0.089	0.089	0.089	0.089	ND		Yes	
Copper	0.025	:	0.025	2 / 3	0.027	0.23	0.0898	0.027	0.025	0.133	Yes	
Iron	0.054	:	0.054	7 / 8	0.04	1800	244.5334	5.15	0.088	6.6	Yes	
Lead	0.005	:	0.005	4 / 8	0.006	0.1	0.0218	0.0055	0.005	0.009	Yes	
Magnesium	0	:	0	7 / 7	0.92	750	172.3814	10	4.8	10	Yes	
Manganese	0	:	0	8 / 8	0.015	150	28.7094	1.38	0.14	0.97	Yes	
Nickel	0	:	0	1 / 1	0.13	0.13	0.13	0.13	ND		Yes	
Potassium	0	:	0	6 / 6	0.74	110	31.1233	17.55	2.6	3.3	Yes	
Sodium	0	:	0	9 / 9	12	10000	1500.367	61	33.8	175	Yes	
Vanadium	0	:	0	1 / 1	0.15	0.15	0.15	0.15	ND		Yes	
Zinc	0	:	0	3 / 3	0.028	22	7.3543	0.035	0.025	0.182	Yes	
Inorganics (mg/L)												
Chloride	2	:	3	55 / 57	3.6	12000	1238.7	110	75	235	Yes	

TABLE 4
IDENTIFICATION OF HUMAN HEALTH OHM OF CONCERN - ZONE II GROUNDWATER

Olin Corporation
Wilmington, MA Facility

OHM	Site Data/Concentration [1] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Median	Background Concentration [2] Median	Maximum	OHM of Concern? [3]	Reason [4]
Nitrate as N	0.05 :	0.2	3 / 7	2.1	24	5.7536	0.2	0.5	6.1	Yes	
Nitrite as N	0.05 :	0.05	2 / 6	0.05	0.17	0.0533	0.05	0.005	0.012	Yes	
Nitrogen, Ammonia	0.04 :	0.1	57 / 62	0.12	4100	184.8082	6.07	0.1	0.54	Yes	
Sulfate as SO4	10 :	10	57 / 58	4.4	48000	4671.493	73.9	20	55	Yes	

Notes:
1 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the reporting limit used as the value for non-detects.
The median represents the median value of all sample results, including non-detects, with the reporting limit used as the value for non-detects.
2 The background data set is presented in Section 4.1 of the Phase II Report and in Attachment 2.
For OHM with site-specific background data, the maximum detected concentration in the background data set and the median concentration are reported.
The median concentration represents the median of all samples in the background data set, with the reporting limit used as the value for non-detects.
3 OHM of Concern are OHM that are inconsistent with background conditions and not detected at a low frequency and low concentration.
4 Reason for exclusion as OHM of Concern:
B = Background; the concentration of OHM in the site data is consistent with the concentration of OHM in the background data, as determined by the following criteria (MADEP, 1995):
For OHM with site-specific background data: (a) the maximum detected site concentration is less than or equal to the maximum site-specific background concentration, and the median site concentration is not more than 50% greater than the median site-specific background concentration; (b) the median site concentration is less than or equal to the median site-specific background concentration and the maximum detected site concentration is not more than 50% greater than the maximum site-specific background concentration; (c) both the maximum and median site concentrations are equal to or less than the maximum and median site-specific background concentrations, respectively.
FC = Low Frequency and Concentration; the OHM was not detected in more than two samples and the maximum detected concentration was not more than two times the minimum SQL.
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
NB = Not judged to be a background analyte (see background discussion).
ND = Not detected in background data set.
NA = Not Available/Not Applicable

TABLE 5
IDENTIFICATION OF HUMAN HEALTH OHM OF CONCERN - SURFACE WATER (HISTORICAL DATA)

Olin Corporation
Wilmington, MA Facility

OHM	Site Data/Concentration [1]							Background Concentration [2]		OHM of Concern? [3]	Reason [4]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Median	Median	Maximum		
VOCs (mg/L)											
1,1,1-Trichloroethane	0.005	0.005	5 / 28	0.001	0.006	0.0026	0.005	NB		Yes	
1,1-Dichloroethane	0.005	0.005	2 / 28	0.001	0.003	0.0025	0.005	ND		No	FC
1,2-Dichloroethene(total)	0.005	0.005	6 / 33	0.001	0.01	0.0031	0.005	ND		Yes	
2,4,4-Trimethyl-1-pentene	0.01	0.01	16 / 28	0.003	0.2	0.0142	0.01	ND		Yes	
2,4,4-Trimethyl-2-Pentene	0.01	0.01	13 / 28	0.001	0.081	0.0071	0.01	ND		Yes	
2-Butanone (MEK)	0.015	0.015	1 / 28	0.018	0.018	0.0077	0.015	ND		No	FC
4-Methyl-2-Pentanone (MIBK	0.015	0.015	3 / 28	0.001	0.002	0.0068	0.015	ND		Yes	
Acetone	0.015	0.015	1 / 28	0.093	0.093	0.009	0.015	ND		Yes	
Bromoform	0.005	0.005	5 / 28	0.001	0.003	0.0024	0.005	ND		Yes	
Chloroethane	0.01	0.01	5 / 28	0.001	0.014	0.0049	0.01	ND		Yes	
Dibromochloromethane	0.005	0.005	1 / 28	0.001	0.001	0.0025	0.005	ND		No	FC
Ethylbenzene	0.005	0.005	3 / 28	0.001	0.003	0.0024	0.005	ND		Yes	
Methylene Chloride	0.01	0.01	7 / 28	0.001	0.003	0.0042	0.01	ND		Yes	
Toluene	0.005	0.005	9 / 28	0.005	0.076	0.0127	0.005	NB		Yes	
Trichloroethene (TCE)	0.005	0.005	8 / 28	0.001	0.013	0.0036	0.005	ND		Yes	
Vinyl Chloride	0.01	0.01	3 / 28	0.002	0.002	0.0047	0.01	ND		Yes	
Xylenes, Total	0.005	0.006	3 / 28	0.005	0.007	0.0029	0.005	NB		Yes	
SVOCs (mg/L)											
1,2,4-Trichlorobenzene	0.01	0.01	1 / 28	0.002	0.002	0.0049	0.01	ND		No	FC
1,4-Dichlorobenzene	0.01	0.01	1 / 28	0.002	0.002	0.0049	0.01	ND		No	FC
2-Methylphenol (o-Cresol)	0.01	0.01	2 / 28	0.001	0.001	0.0047	0.01	ND		No	FC
4-Nitrophenol	0.025	0.025	2 / 28	0.0025	0.003	0.0118	0.025	ND		No	FC
Benzo(a)Pyrene	0.01	0.01	1 / 28	0.001	0.001	0.0049	0.01	ND		No	FC
Di-n-butylphthalate	0.01	0.01	1 / 28	0.001	0.001	0.0049	0.01	ND		No	FC
Di-n-octylphthalate	0.01	0.01	4 / 28	0.001	0.0085	0.0049	0.01	ND		Yes	
N-Nitrosodiphenylamine	0.01	0.01	9 / 28	0.002	0.031	0.0052	0.01	ND		Yes	
Phenol	0.01	0.01	6 / 28	0.001	0.003	0.0044	0.01	ND		Yes	
bis(2-EthylHexyl)phthalate	0.01	0.17	19 / 28	0.002	0.074	0.0131	0.008	ND		Yes	
Pesticides/PCBs (mg/L)											
Heptachlor Epoxide	0.0001	0.0001	1 / 28	0.0002	0.0002	0.0001	0.0001	ND		No	FC
Metals (mg/L)											
Aluminum	0.1	0.1	24 / 28	0.17	34	4.6968	2.1	0.1	0.37	Yes	
Arsenic	0.005	0.005	7 / 28	0.005	0.25	0.0145	0.005	ND		Yes	
Barium	0	0	27 / 27	0.007	0.055	0.0242	0.021	0.018	0.034	Yes	
Calcium	0	0	28 / 28	4	140	33.2821	29.5	18	28	Yes	
Chromium	0.015	0.015	19 / 28	0.022	9.9	0.6743	0.1035	ND		Yes	
Cobalt	0.015	0.015	5 / 28	0.016	0.11	0.0138	0.015	ND		Yes	
Copper	0.025	0.025	1 / 28	0.12	0.12	0.0163	0.025	ND		Yes	

TABLE 5
IDENTIFICATION OF HUMAN HEALTH OHM OF CONCERN - SURFACE WATER (HISTORICAL DATA)

Olin Corporation
Wilmington, MA Facility

OHM	Site Data/Concentration [1] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Median	Background Concentration [2] Median	Maximum	OHM of Concern? [3]	Reason [4]
Hexavalent Chromium	0.015	0.015	4 / 10	0.024	0.2	0.0374	0.015	ND		Yes	
Iron	0	0	28 / 28	0.048	72	5.5506	1.875	0.235	1.8	Yes	
Lead	0.005	0.005	5 / 28	0.006	0.18	0.0112	0.005	ND		Yes	
Magnesium	0	0	28 / 28	1.8	17	5.3071	4.9	2.7	3.4	Yes	
Manganese	0	0	28 / 28	0.013	4.4	0.8564	0.75	0.042	0.1	Yes	
Mercury	0.0002	0.0002	1 / 28	0.0009	0.0009	0.0001	0.0002	ND		Yes	
Nickel	0.04	0.04	2 / 28	0.049	0.11	0.0243	0.04	ND		Yes	
Potassium	0	0	28 / 28	0.45	6.6	2.7096	2.65	2.4	3.3	Yes	
Sodium	0	0	28 / 28	7	260	97.3214	75.5	44	58	Yes	
Vanadium	0.025	0.025	1 / 28	0.19	0.19	0.0188	0.025	ND		Yes	
Zinc	0.025	0.025	25 / 28	0.026	0.2	0.0704	0.0635	0.025	0.048	Yes	
Inorganics (mg/L)											
Chloride	0	0	28 / 28	13	260	108.3571	91	71	110	Yes	
Nitrate as N	0	0	6 / 6	0.2	6.6	3.7583	4.075	NB		Yes	
Nitrite as N	0.05	0.05	3 / 11	0.054	0.331	0.0609	0.05	NB		Yes	
Nitrogen, Ammonia	0.1	0.1	26 / 28	0.26	110	27.4361	20.5	ND		Yes	
Sulfate as SO4	0	0	28 / 28	26	830	236.75	215	21	24	Yes	

Notes:
1 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the reporting limit used as the value for non-detects.
The median represents the median value of all sample results, including non-detects, with the reporting limit used as the value for non-detects.
2 The background data set is presented in Section 4.1 of the Phase II Report and in Attachment 2.
For OHM with site-specific background data, the maximum detected concentration in the background data set and the median concentration are reported.
The median concentration represents the median of all samples in the background data set, with the reporting limit used as the value for non-detects.
3 OHM of Concern are OHM that are inconsistent with background conditions and not detected at a low frequency and low concentration.
4 Reason for exclusion as OHM of Concern:
B = Background; the concentration of OHM in the site data is consistent with the concentration of OHM in the background data, as determined by the following criteria (MADEP, 1995):
For OHM with site-specific background data: (a) the maximum detected site concentration is less than or equal to the maximum site-specific background concentration, and the median site concentration is not more than 50% greater than the median site-specific background concentration; (b) the median site concentration is less than or equal to the median site-specific background concentration and the maximum detected site concentration is not more than 50% greater than the maximum site-specific background concentration; (c) both the maximum and median site concentrations are equal to or less than the maximum and median site-specific background concentrations, respectively.
FC = Low Frequency and Concentration; the OHM was not detected in more than two samples and the maximum detected concentration was not more than two times the minimum SQL.
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
NB = Not judged to be a background analyte (see background discussion).

TABLE 5
IDENTIFICATION OF HUMAN HEALTH OHM OF CONCERN - SURFACE WATER (HISTORICAL DATA)

Olin Corporation
Wilmington, MA Facility

	Site Data/Concentration [1]							Background Concentration [2]			
	Minimum	Maximum	Frequency of			Arithmetic				OHM of	
OHM	SQL	SQL	Detection	Minimum	Maximum	Mean	Median	Median	Maximum	Concern? [3]	Reason [4]

ND = Not detected in background data set.
NA = Not Available/Not Applicable
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 6
IDENTIFICATION OF HUMAN HEALTH OHM OF CONCERN - SURFACE WATER (RECENT DATA)

Olin Corporation
Wilmington, MA Facility

OHM	Site Data/Concentration [1]							Background Concentration [2]		OHM of Concern? [3]	Reason [4]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Median	Median	Maximum		
Metals (mg/L)											
Aluminum	0.1 :	0.1	7 / 8	0.11	2.4	0.7813	0.56	0.1	0.37	Yes	
Arsenic	0.005 :	0.008	1 / 8	0.01	0.01	0.0036	0.005	ND		No	FC
Barium	0 :	0	8 / 8	0.01	0.038	0.0216	0.0195	0.018	0.034	Yes	
Calcium	0 :	0	8 / 8	7.3	280	88.35	49.5	18	28	Yes	
Chromium	0.015 :	0.015	3 / 8	0.0195	0.023	0.0125	0.015	ND		Yes	
Trivalent Chromium	0.015 :	0.015	2 / 7	0.0195	0.023	0.0114	0.015	NB		No	FC
Iron	0.37 :	0.53	6 / 8	0.082	5.6	1.5715	0.645	0.235	1.8	Yes	
Magnesium	0 :	0	8 / 8	0.91	6.3	3.4138	2.9	2.7	3.4	Yes	
Manganese	0 :	0	8 / 8	0.014	0.775	0.3609	0.36	0.042	0.1	Yes	
Potassium	3 :	3	7 / 8	1.1	4.8	2.5	2.5	2.4	3.3	Yes	
Sodium	0 :	0	8 / 8	16	130	68.75	61.5	44	58	Yes	
Zinc	0 :	0	1 / 1	0.025	0.025	0.025	0.025	0.025	0.048	No	B
Inorganics (mg/L)											
Chloride	0 :	0	8 / 8	24	160	76.625	75	71	110	Yes	
Nitrate & Nitrite as N	0 :	0	1 / 1	6.8	6.8	6.8	6.8	NB		Yes	
Nitrate as N	0.05 :	0.05	6 / 7	0.25	7.2	2.2321	0.7	NB		Yes	
Nitrogen, Ammonia	0.05 :	0.05	6 / 7	0.1	91	27.1321	6.8	ND		Yes	
Sulfate as SO4	0 :	0	8 / 8	25	1100	347.375	205	21	24	Yes	
Sulfide	1 :	1	3 / 7	2	5	1.25	1	NB		Yes	

Notes:

1 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the reporting limit used as the value for non-detects.
The median represents the median value of all sample results, including non-detects, with the reporting limit used as the value for non-detects.

2 The background data set is presented in Section 4.1 of the Phase II Report and in Attachment 2.
For OHM with site-specific background data, the maximum detected concentration in the background data set and the median concentration are reported.
The median concentration represents the median of all samples in the background data set, with the reporting limit used as the value for non-detects.

3 OHM of Concern are OHM that are inconsistent with background conditions and not detected at a low frequency and low concentration.

4 Reason for exclusion as OHM of Concern:
B = Background; the concentration of OHM in the site data is consistent with the concentration of OHM in the background data, as determined by the following criteria (MADEP, 1995):
For OHM with site-specific background data: (a) the maximum detected site concentration is less than or equal to the maximum site-specific background concentration, and the median site concentration is not more than 50% greater than the median site-specific background concentration; (b) the median site concentration is less than or equal to the median site-specific background concentration and the maximum detected site concentration is not more than 50% greater than the maximum site-specific background concentration; (c) both the maximum and median site concentrations are equal to or less than the maximum and median site-specific background concentrations, respectively.
FC = Low Frequency and Concentration; the OHM was not detected in more than two samples and the maximum detected concentration was not more than two times the minimum SQL.

TABLE 6
IDENTIFICATION OF HUMAN HEALTH OHM OF CONCERN - SURFACE WATER (RECENT DATA)

Olin Corporation
Wilmington, MA Facility

	Site Data/Concentration [1]							Background Concentration [2]			
OHM	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Median	Median	Maximum	OHM of Concern? [3]	Reason [4]

OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
NB = Not judged to be a background analyte (see background discussion).
ND = Not detected in background data set.
NA = Not Available/Not Applicable
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 7
IDENTIFICATION OF HUMAN HEALTH OHM OF CONCERN - SEDIMENT

Olin Corporation
Wilmington, MA Facility

OHM	Site Data/Concentration [1] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Median	Background Concentration [2] Median	Maximum	OHM of Concern? [3]	Reason [4]
VOCs (mg/Kg)											
1,1,1-Trichloroethane	0.005 :	1	5 / 52	0.006	47	0.9197	0.009	NB		Yes	
1,1,2,2-Tetrachloroethane	0.002 :	1	4 / 50	0.002	0.016	0.0158	0.008	ND		Yes	
1,1-Dichloroethane	0.005 :	1	12 / 51	0.003	0.034	0.0164	0.008	ND		Yes	
1,1-Dichloroethene	0.005 :	1	2 / 50	0.0025	0.003	0.0159	0.0085	ND		No	FC
1,2-Dichloroethane	0.005 :	1	2 / 50	0.004	0.004	0.0159	0.008	ND		No	FC
1,2-Dichloroethene(total)	0.005 :	1	6 / 51	0.007	0.12	0.0186	0.009	ND		Yes	
1,2-Dichloropropane	0.005 :	1	1 / 50	0.04	0.04	0.0163	0.0085	ND		Yes	
2,4,4-Trimethyl-1-pentene	0.01 :	0.05	40 / 52	0.002	28	1.4621	0.05	ND		Yes	
2,4,4-Trimethyl-2-pentene	0.01 :	0.05	35 / 52	0.002	9.4	0.4664	0.023	ND		Yes	
2-Butanone (MEK)	0.015 :	3	8 / 49	0.012	0.28	0.057	0.03	NB		Yes	
2-Hexanone	0.015 :	3	2 / 50	0.02	0.036	0.0477	0.02	ND		Yes	
Acetone	0.015 :	3	22 / 52	0.007	1.7	0.1697	0.0625	NB		Yes	
Benzene	0.005 :	1	5 / 51	0.003	0.018	0.0164	0.009	ND		Yes	
Bromodichloromethane	0.005 :	1	2 / 50	0.004	0.0065	0.016	0.0085	ND		*No*	FC
Bromoform	0.005 :	1	5 / 50	0.003	0.102	0.0194	0.009	ND		Yes	
Carbon Disulfide	0.01 :	10	3 / 51	0.003	0.005	0.1286	0.02	ND		Yes	
Carbon Tetrachloride	0.005 :	1	2 / 50	0.005	0.011	0.016	0.0085	ND		Yes	
Chlorobenzene	0.005 :	1	6 / 51	0.002	0.014	0.0158	0.008	ND		Yes	
Chloroform	0.005 :	1	5 / 50	0.003	0.009	0.0159	0.008	ND		Yes	
Dibromochloromethane	0.005 :	1	3 / 50	0.004	0.026	0.0166	0.009	ND		Yes	
Ethylbenzene	0.005 :	0.046	7 / 50	0.003	0.71	0.0224	0.0085	ND		Yes	
Methylene Chloride	0.01 :	2	12 / 51	0.004	0.024	0.0305	0.02	NB		Yes	
Styrene	0.005 :	1	3 / 50	0.004	0.007	0.0159	0.008	ND		Yes	
Tetrachloroethene (PCE)	0.005 :	1	6 / 50	0.003	0.032	0.0162	0.008	ND		Yes	
Toluene	0.005 :	1	17 / 51	0.002	1.1	0.0373	0.008	ND		Yes	
Trichloroethene (TCE)	0.005 :	1	15 / 51	0.002	0.15	0.0201	0.008	NB		Yes	
Vinyl Chloride	0.01 :	2	3 / 51	0.002	0.012	0.0309	0.02	ND		Yes	
Xylenes, Total	0.005 :	1	10 / 50	0.002	0.25	0.0211	0.008	NB		Yes	
bis(Chloromethyl)ether	0.5 :	0.5	1 / 2	0.57	0.57	0.41	0.535	ND		No	FC
SVOCs (mg/Kg)											
1,2,4-Trichlorobenzene	0.4 :	1200	7 / 58	0.076	1.4	31.9013	0.55	ND		Yes	
1,2-Dichlorobenzene	0.4 :	1200	1 / 58	1.6	1.6	31.9435	0.6	ND		Yes	
2-Methylnaphthalene	0.4 :	1200	2 / 58	0.067	1.4	31.9369	0.6	ND		Yes	
4-Bromophenyl-phenylether	0.4 :	1200	12 / 58	0.15	3.4	32.0794	0.6	ND		Yes	
4-Chlorophenyl-phenylether	0.4 :	1200	8 / 58	0.058	2.3	31.9876	0.6	ND		Yes	
4-Methylphenol(p-Cresol)	0.4 :	1200	2 / 58	0.089	0.72	31.9687	0.6	ND		No	FC
Acenaphthene	0.4 :	1200	2 / 58	0.081	0.25	32.0001	0.6	ND		No	FC
Acenaphthylene	0.4 :	1200	1 / 53	0.021	0.021	34.9479	0.6	ND		No	FC

TABLE 7
IDENTIFICATION OF HUMAN HEALTH OHM OF CONCERN - SEDIMENT

Olin Corporation
Wilmington, MA Facility

OHM	Site Data/Concentration [1] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Median	Background Concentration [2] Median	Maximum	OHM of Concern? [3]	Reason [4]
Anthracene	0.4	1200	12 / 58	0.028	0.52	31.9488	0.5	ND		Yes	
Benzo(a)Anthracene	0.4	1200	21 / 58	0.055	2.1	32.0085	0.5	ND		Yes	
Benzo(a)Pyrene	0.4	1200	20 / 58	0.059	2	32.0292	0.5	NB		Yes	
Benzo(b)Fluoranthene	0.4	1200	26 / 58	0.052	4.4	32.1502	0.5	NB		Yes	
Benzo(g,h,i)Perylene	0.4	1200	17 / 58	0.056	2.1	32.0263	0.5	ND		Yes	
Benzo(k)Fluoranthene	0.4	1200	14 / 57	0.053	1.4	32.5274	0.5	ND		Yes	
Benzoic Acid	2	5800	10 / 57	0.085	3.4	157.1135	2	ND		Yes	
Benzyl Alcohol	0.4	1200	1 / 57	0.27	0.27	32.4982	0.6	ND		No	FC
Butylbenzylphthalate	0.4	1200	17 / 57	0.066	160	36.523	0.6	ND		Yes	
Chrysene	0.4	1200	23 / 58	0.093	3.4	32.1357	0.595	NB		Yes	
Di-n-butylphthalate	0.4	1200	22 / 59	0.016	2100	83.0969	0.5	ND		Yes	
Di-n-octylphthalate	0.4	1200	22 / 59	0.054	24	32.0624	0.6	ND		Yes	
Dibenzo(a,h)Anthracene	0.4	1200	4 / 58	0.12	0.43	31.9785	0.55	ND		Yes	
Dibenzofuran	0.4	1200	5 / 58	0.098	5.9	31.9949	0.6	ND		Yes	
Diethylphthalate	0.4	1200	2 / 58	0.12	0.79	31.9704	0.6	ND		No	FC
Dimethylphthalate	0.4	1200	3 / 58	0.12	0.53	31.9777	0.6	ND		Yes	
Fluoranthene	0.4	1200	33 / 58	0.065	4.5	32.2798	0.51	NB		Yes	
Fluorene	0.4	1200	7 / 58	0.092	4	31.9584	0.6	ND		Yes	
Indeno (1,2,3-cd)Pyrene	0.4	1200	23 / 58	0.069	13	32.2439	0.5	ND		Yes	
N-Nitrosodiphenylamine	0.4	550	37 / 59	0.06	6200	212.6918	0.72	ND		Yes	
Naphthalene	0.4	1200	4 / 59	0.053	53	32.3051	0.6	ND		Yes	
Nitrobenzene	0.4	1200	1 / 57	0.067	0.067	32.556	0.6	ND		No	FC
Phenanthrene	0.4	1200	32 / 58	0.054	34	32.8075	0.5	ND		Yes	
Phenol	0.4	1100	13 / 59	0.069	56	22.2195	0.5	ND		Yes	
Pyrene	0.4	1200	36 / 59	0.07	9.1	31.6864	0.5	NB		Yes	
bis(2-EthylHexyl)phthalate	0.4	37	52 / 58	0.082	150000	5880.484	61	NB		Yes	
Pesticides/PCBs (mg/Kg)											
4,4'-DDD	0.004	2	2 / 59	0.007	0.19	0.0659	0.05	0.0076	0.26	Yes	
4,4'-DDT	0.004	2	5 / 59	0.0044	1.2	0.0809	0.05	0.0085	0.031	Yes	
Aldrin	0.002	0.9	4 / 58	0.046	0.45	0.0401	0.02	ND		Yes	
Alpha-BHC	0.002	0.9	1 / 58	0.0052	0.0052	0.0325	0.02	ND		Yes	
Alpha-Chlordane	0.0022	9	5 / 57	0.025	1.6	0.2824	0.1	0.0044	0.0056	Yes	
Beta-BHC	0.002	0.9	5 / 57	0.0031	0.46	0.0415	0.02	ND		Yes	
Delta-BHC	0.002	0.9	6 / 58	0.0054	0.12	0.0353	0.02	ND		Yes	
Dieldrin	0.004	2	2 / 59	0.0067	0.0072	0.0645	0.05	0.0092	0.027	No	FC
Endosulfan I	0.002	0.9	7 / 58	0.0032	0.41	0.0401	0.02	ND		Yes	
Endosulfan Sulfate	0.004	2	7 / 59	0.047	0.24	0.0739	0.05	ND		Yes	
Endrin	0.004	2	3 / 59	0.0082	0.61	0.0688	0.05	ND		Yes	
Endrin Aldehyde	0.004	0.6	14 / 59	0.012	6.5	0.2099	0.05	ND		Yes	

TABLE 7
IDENTIFICATION OF HUMAN HEALTH OHM OF CONCERN - SEDIMENT

Olin Corporation
Wilmington, MA Facility

OHM	Site Data/Concentration [1]							Background Concentration [2]		OHM of Concern? [3]	Reason [4]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Median	Median	Maximum		
Endrin Ketone	0.004	2	3 / 59	0.011	0.4	0.0682	0.05	ND		Yes	
Gamma-Chlordane	0.0022	9	6 / 58	0.0036	1.6	0.2796	0.12	0.0044	0.0053	Yes	
Heptachlor	0.002	0.9	3 / 58	0.0006	0.54	0.0387	0.02	ND		Yes	
Heptachlor Epoxide	0.002	0.3	4 / 57	0.0046	0.16	0.0277	0.02	ND		Yes	
Methoxychlor	0.02	9	1 / 58	0.29	0.29	0.3282	0.2	ND		Yes	
Metals (mg/Kg)											
Aluminum	0	0	59 / 59	7.3	150000	11351.13	5200	6300	12000	Yes	
Antimony	0.96	92	25 / 58	0.05	250	27.6072	20	ND		Yes	
Arsenic	0.5	23	56 / 58	0.0053	440	34.2761	5.1	8.5	44	Yes	
Barium	0	0	59 / 59	0.0097	250	27.8766	14	32.5	45	Yes	
Beryllium	0.0015	6.9	7 / 57	0.22	10.4	1.0615	1.5	ND		Yes	
Cadmium	0.001	2.4	13 / 57	0.4	14	1.1689	1	ND		Yes	
Calcium	0	0	59 / 59	1	9900	1345.293	760	2100	4100	Yes	
Chromium	0	0	59 / 59	2.1	13800	1316.568	450	13	19.5	Yes	
Cobalt	1.5	2.4	49 / 59	0.0044	39	6.329	3.4	6.7	6.7	Yes	
Copper	2.5	2.5	54 / 57	0.02	280	34.7146	12	21	33	Yes	
Hexavalent Chromium	*0*	*0*	*2 / 2*	*0.087*	*0.14*	*0.1135*	*0.11*	*0.53*	*1.2*	*No*	B
Iron	0	0	59 / 59	6.8	140000	19013.84	6500	6400	14000	Yes	
Lead	10	35	33 / 57	0.012	790	45.4128	10	26.5	89	Yes	
Magnesium	0	0	59 / 59	0.56	3500	980.5292	809	1200	3200	No	B
Manganese	0	0	59 / 59	0.069	1900	140.6093	52	128	680	Yes	
Mercury	0.0001	0.28	25 / 59	0.0001	1.3	0.2333	0.13	0.27	0.54	Yes	
Nickel	4	6.3	46 / 59	0.01	110	10.6349	6.4	9.6	15.5	Yes	
Potassium	0	0	59 / 59	0.34	1700	455.182	330	490	805	Yes	
Selenium	0.0005	11	1 / 58	0.78	0.78	0.7147	0.52	ND		Yes	
Silver	0.0015	6.9	2 / 57	2.7	5.8	1.0448	1.5	ND		Yes	
Sodium	0	0	59 / 59	0.18	1600	223.1932	150	114	290	Yes	
Thallium	0.0008	5.9	1 / 58	3	3	0.6298	0.66	3.4	3.6	No	B
Vanadium	2.5	2.5	57 / 59	0.009	93	16.1902	10	16	26	Yes	
Zinc	2.5	2.5	58 / 59	0.026	1100	89.7485	25	61.5	130	Yes	
Inorganics (mg/Kg)											
Chloride	40	40	35 / 51	0.064	1400	121.1509	60	NB		Yes	
Nitrate as N	1	1	6 / 7	0.0014	3.7	1.8218	2.6	NB		Yes	
Nitrite as N	0.001	1	1 / 6	2.2	2.2	0.7001	1	NB		Yes	
Nitrogen, Ammonia	8	8	51 / 56	0.16	1000	132.9618	86	ND		Yes	
Sulfate as SO4	40	40	50 / 51	80	18000	1286.882	490	ND		Yes	

Notes:
1 Samples included in Site Data set are presented in Attachment 1.

TABLE 7
IDENTIFICATION OF HUMAN HEALTH OHM OF CONCERN - SEDIMENT

Olin Corporation
Wilmington, MA Facility

OHM	Site Data/Concentration [1]							Background Concentration [2]		OHM of Concern? [3]	Reason [4]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Median	Median	Maximum		

Duplicate samples were averaged with their original samples prior to calculation of statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the reporting limit used as the value for non-detects.
The median represents the median value of all sample results, including non-detects, with the reporting limit used as the value for non-detects.

2 The background data set is presented in Section 4.1 of the Phase II Report and in Attachment 2.
For OHM with site-specific background data, the maximum detected concentration in the background data set and the median concentration are reported.
The median concentration represents the median of all samples in the background data set, with the reporting limit used as the value for non-detects.

3 OHM of Concern are OHM that are inconsistent with background conditions and not detected at a low frequency and low concentration.

4 Reason for exclusion as OHM of Concern:
B = Background; the concentration of OHM in the site data is consistent with the concentration of OHM in the background data, as determined by the following criteria (MADEP, 1995):
For OHM with site-specific background data: (a) the maximum detected site concentration is less than or equal to the maximum site-specific background concentration, and the median site concentration is not more than 50% greater than the median site-specific background concentration; (b) the median site concentration is less than or equal to the median site-specific background concentration and the maximum detected site concentration is not more than 50% greater than the maximum site-specific background concentration; (c) both the maximum and median site concentrations are equal to or less than the maximum and median site-specific background concentrations, respectively.
FC = Low Frequency and Concentration; the OHM was not detected in more than two samples and the maximum detected concentration was not more than two times the minimum SQL.

OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
NB = Not judged to be a background analyte (see background discussion).
ND = Not detected in background data set.
NA = Not Available/Not Applicable
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 8
POTENTIAL EXPOSURE PATHWAYS

Olin Corporation
Wilmington, MA Facility

RECEPTOR	POTENTIAL EXPOSURE MEDIUM AND ROUTE	IS PATHWAY COMPLETE?	PATHWAY EVALUATED	REASON FOR SELECTION OR EXCLUSION
On-site Resident with Private Well	**Groundwater**			
	Ingestion	No, residential use will not occur in the future.	No	AUL
	Dermal contact		No	
	Inhalation of vapors		No	
	Indoor Air			
	Inhalation of vapors migrating from groundwater	No, residential use will not occur in the future.	No	AUL
	Surface Water			
	Ingestion	No, residential use will not occur in the future.	No	AUL
	Dermal contact		No	
	Sediment			
	Ingestion	No, residential use will not occur in the future.	No	AUL
	Dermal Contact		No	
	Surface Soil			
	Incidental ingestion	No, residential use will not occur in the future.	No	AUL
	Dermal contact		No	
	Inhalation of vapors and particulates		No	
	Ingestion of home-grown produce		No	
	Subsurface Soil			
	Incidental ingestion	No, residential use will not occur in the future.	No	AUL
	Dermal contact		No	
	Inhalation of vapors and particulates		No	
On-site Resident on Public Water Supply	**Groundwater**			
	Ingestion	No, residential use will not occur in the future.	No	AUL
	Dermal contact		No	
	Inhalation of vapors		No	
	Indoor Air			
	Inhalation of vapors migrating from groundwater	No, residential use will not occur in the future.	No	AUL
	Surface Water			
	Ingestion	No, residential use will not occur in the future.	No	AUL
	Dermal contact		No	
	Sediment			
	Ingestion	No, residential use will not occur in the future.	No	AUL
	Dermal Contact		No	
	Surface Soil			
	Incidental ingestion	No, residential use will not occur in the future.	No	AUL
	Dermal contact		No	
	Inhalation of particulates		No	
	Inhalation of vapors and particulates		No	

TABLE 8
POTENTIAL EXPOSURE PATHWAYS

Olin Corporation
Wilmington, MA Facility

RECEPTOR	POTENTIAL EXPOSURE MEDIUM AND ROUTE	IS PATHWAY COMPLETE?	PATHWAY EVALUATED	REASON FOR SELECTION OR EXCLUSION
On-site Resident	**Subsurface Soil**			
on Public Water	Incidental ingestion	No, residential use will not	No	AUL
Supply (cont)	Dermal contact	occur in the future.	No	
	Inhalation of vapors and particulates		No	
On-Site	**Surface Soil**			
Worker	Incidental ingestion	Yes; current and	Yes	Workers on site could be exposed.
	Dermal contact	future exposures	Yes	Surface soil VOCs were detected at low
	Inhalation of vapors	could occur	No	concentrations and site is paved and
	Inhalation of particulates		Yes	vegetated. On-site work may generate dust.
	Subsurface Soil			
	Incidental ingestion	No; current exposures do	No	AUL
	Dermal contact	not occur, and future	No	
	Inhalation of vapors	exposures will not occur	No	
	Inhalation of particulates		No	
	Surface Water	Yes; current and		Workers may be exposed to surface water
	Ingestion	future exposures	Yes	when replacing hay bales along ditch. Future
	Dermal contact	could occur	Yes	workers may be exposed incidentally.
	Sediment	Yes; current and	Yes	Workers may be exposed to surface water
	Ingestion	future exposures	Yes	when replacing hay bales along ditch. Future
	Dermal Contact	could occur		workers may be exposed incidentally.
	Groundwater (on-site)			
	Ingestion	No; current exposures do	No	AUL
	Dermal contact	not occur, and future	No	
	Inhalation of vapors	exposures will not occur	No	
	Groundwater (public water)			
	Ingestion	Yes; future exposures	Yes	Workers on-site could be exposed if using
	Dermal contact [1]	could occur.	No	public water for drinking; substantial
	Inhalation of vapors [1]		No	inhalation and dermal exposures are unlikely.
	Indoor Air			
	Inhalation of vapors	No current exposures;	Yes	If buildings are constructed over the
	migrating from	future exposures		volatile plume, VOCs could migrate
	groundwater	could occur		through the foundation
Off-Site	**Groundwater (beneath facility; used as process water)**			
Worker	Ingestion	Yes; current and future	No	Workers may contact water and inhale
	Dermal contact	exposures could occur	Yes	VOCs released from groundwater used
	Inhalation of vapors		Yes	as process water. Ingestion exposures would not occur.
	Groundwater (public water)			
	Ingestion	Yes; current and future exposures	Yes	Workers off-site could be exposed if
	Dermal contact [1]	could occur.	No	using public water for drinking; substantial
	Inhalation of vapors [1]		No	inhalation/dermal exposures are unlikely.

TABLE 8
POTENTIAL EXPOSURE PATHWAYS

Olin Corporation
Wilmington, MA Facility

RECEPTOR	POTENTIAL EXPOSURE MEDIUM AND ROUTE	IS PATHWAY COMPLETE?	PATHWAY EVALUATED	REASON FOR SELECTION OR EXCLUSION
Off-Site	**Indoor Air**			
Worker (cont)	Inhalation of vapors	Yes; current and	Yes	VOCs may migrate through foundations
	migrating from	future exposures		and building slabs overlying
	groundwater	could occur		the shallow groundwater volatile plume.
On-Site Utility	**Surface and Subsurface Soil**			
Worker	Incidental ingestion	Yes, current and future	Yes	Utility workers could excavate
	Dermal contact	exposure could occur	Yes	subsurface soils and be exposed.
	Inhalation of vapors		Yes	
	Inhalation of dust		Yes	
	Surface and Subsurface Soil			
	in Area of Drum Disposal Area			
	Incidental ingestion	Yes, current and future	Yes	Utility workers could excavate
	Dermal contact	exposure could occur	Yes	subsurface soils and be exposed.
	Inhalation of vapors		Yes	
	Inhalation of dust		Yes	
On-Site Construction	**Surface and Subsurface Soil**			
Worker	Incidental ingestion	No current exposures;	Yes	Future use of the site could include
	Dermal contact	future exposures	Yes	construction of a commercial building;
	Inhalation of vapors	could occur	Yes	site workers could be exposed
	Inhalation of dust		Yes	
	Surface and Subsurface Soil			
	in Area of Drum Disposal Area			
	Incidental ingestion	No current exposures;	Yes	Future use of the site could include
	Dermal contact	future exposures	Yes	construction of a commercial building;
	Inhalation of vapors	could occur	Yes	site workers could be exposed
	Inhalation of dust		Yes	
Nearby Resident	**Groundwater**			
with Private Well-	Ingestion	No; currently use public	No	Purchase of groundwater rights
West Plume	Dermal contact	water; future exposures	No	
	Inhalation of vapors	will not occur	No	
Nearby Resident	**Groundwater**			
with Private Well	Ingestion	No; currently use public	No	Purchase of groundwater rights
Sulfate Landfill	Dermal contact	water; future exposures	No	
Plume	Inhalation of vapors	will not occur	No	
Nearby Resident	**Groundwater**			
with Private Well-	Ingestion	No; currently use public	No	No evidence of
Border Ave.	Dermal contact	water; future exposures	No	site-related
	Inhalation of vapors	will not occur	No	contamination
Nearby Resident	**Groundwater**			
with Private Well-	Ingestion	No; currently use public	No	No evidence of
Cook Ave. Bedrock	Dermal contact	water; future exposures	No	site-related
	Inhalation of vapors	will not occur	No	contamination

TABLE 8
POTENTIAL EXPOSURE PATHWAYS

Olin Corporation
Wilmington, MA Facility

RECEPTOR	POTENTIAL EXPOSURE MEDIUM AND ROUTE	IS PATHWAY COMPLETE?	PATHWAY EVALUATED	REASON FOR SELECTION OR EXCLUSION
Nearby Resident on Public Water Supply	**Groundwater**			
	Ingestion	Yes; future exposures could occur	Yes	Residents connected to public water supply;
	Dermal contact [1]		No	
	Inhalation of vapors [1]		No	
	Surface Water	Yes; current off-site exposures could occur. Future on- and off-site exposures could occur if fence was removed		Exposures could occur during wading by neighborhood children
	Ingestion		Yes	
	Dermal contact		Yes	
	Sediment	Yes; current off-site exposures could occur. Future on- and off-site exposures could occur if fence was removed		Exposures could occur during wading by neighborhood children
	Ingestion		Yes	
	Dermal Contact		Yes	
	Surface Soil	Yes; future exposures could occur. Currently an eight-foot high fence surrounds facility		
	Incidental ingestion		Yes	Exposures could occur during trespassing by neighborhood children.
	Dermal contact		Yes	
	Inhalation of vapors and particulates		No	Surface soil VOCs were detected at low concentrations and site is paved and vegetated
	Subsurface Soil			
	Incidental ingestion	No; current exposures do not occur, and future exposures will not occur	No	AUL
	Dermal contact		No	
	Inhalation of vapors and particulates		No	
	Indoor Air			
	Inhalation of vapors migrating from groundwater	No; current and future exposures will not occur	No	Site-related volatile OHM present in shallow groundwater only in industrial area west of Facility

Notes:
1 No VOCs were detected in finished drinking water from the Butters Row Treatment Plant.
AUL = Activity and Use Limitation
VOCs = volatile organic compounds

TABLE 9
IDENTIFICATION OF POTENTIAL HOT SPOTS - SURFACE SOIL

Olin Corporation
Wilmington, MA Facility

OHM [1]	Potential Hot Spots							
	Area with Buildings [2]				Area without Buildings [3]			
	Non-hot spot	SWMU 27	Lake Poly	Drum Area A	Non-hot spot	Area 8	SWMU 30	SWMU 33
VOCs (mg/Kg)								
1,1,1-Trichloroethane	0	0	0.0066	0.0068	0.0237	0.0067	0	0
1,1-Dichloroethane	0	0	0.001	0	0	0	0	0
1,1-Dichloroethene	0	0	0	0	0.0043	0	0	0
1,2-Dichloroethane	0	0	0.001	0	0	0	0	0
2,4,4-Trimethyl-1-pentene	0	0	0	0	0	0.0043	0	0
2,4,4-Trimethyl-2-Pentene	0	0	0	0	0	0.0036	0	0
2-Butanone (MEK)	0	0	0.004	0	0	0.004	0	0
4-Methyl-2-Pentanone (MIBK)	0	0	0	0	0	0	0.007	0
Acetone	0	0.093	0.0212	0.012	0.0153	0.0208	0	0
Benzene	0	0	0.001	0	0	0	0	0
Methylene Chloride	0	0.047	0.002	0	0.0052	0.0054	0	0
Styrene	0	0	0.001	0	0	0	0	0
Tetrachloroethene (PCE)	0.001	0.073 **	0	0	0	0	0	0.001
Toluene	0.0027	0.015	0.001	0.0009	0.0034	0.0033	0.013	0.001
Trichloroethene (TCE)	0	0	0	0	0.0039	0	0	0
Xylenes, Total	0	0	0.002	0	0	0	0	0
SVOCs (mg/Kg)								
1,2,4-Trichlorobenzene	0	0	0	0	0	0.25	0	0
2-Methylnaphthalene	0.075	0	0	0	0	27.0453	0	0
2-Methylphenol (o-Cresol)	0	0	0	0	0	0.049	0	0
4-Methylphenol(p-Cresol)	0	0	0	0	0	0.34	0	0
Acenaphthene	0	0	0	0	0	8.4841	0	0
Acenaphthylene	0.057	0	0.027	0	0.045	20.3667 *	0	0
Anthracene	0.069	0.002	0.022	0	0.005	14.1153 *	0	0.035
Benzo(a)Anthracene	0.1434	0.008	0.07	0	0.099	7.0161 **	0	0
Benzo(a)Pyrene	0.1074	0	0	0	0.059	5.1281 **	0	0

TABLE 9
IDENTIFICATION OF POTENTIAL HOT SPOTS - SURFACE SOIL

Olin Corporation
Wilmington, MA Facility

	Potential Hot Spots							
	Area with Buildings [2]				Area without Buildings [3]			
OHM [1]	Non-hot spot	SWMU 27	Lake Poly	Drum Area A	Non-hot spot	Area 8	SWMU 30	SWMU 33
Benzo(b)Fluoranthene	0.1894	0.01	0.107	0	0.18	2.4527 **	0	0
Benzo(g,h,i)Perylene	0.12	0	0	0	0	1.7607	0	0
Benzo(k)Fluoranthene	0.125	0.006	0.0925	0	0.065	3.4991 **	0	0
Benzoic Acid	0	0.1	0.096	0	0.79	1.8	0	0
Butylbenzylphthalate	0.13	1.02	0.029	0	0	0.8	0	0
Chrysene	0.2213	0.012	0.088	0	0.17	7.4942 **	0	0
Di-n-butylphthalate	0.036	3.3567 **	0.3512	0.165	0.065	1.4 **	0.4	0.172
Di-n-octylphthalate	0.053	1.72 **	0.022	0	0	0.17	0	0
Dibenzo(a,h)Anthracene	0.074	0	0	0	0	0	0	0
Dibenzofuran	0	0	0.016	0	0	2.246	0	0
Diethylphthalate	0.033	0.033	0.0245	0	0.044	0.053	0	0.085
Dimethylphthalate	0.064	0	0	0	0	0	0	0
Fluoranthene	0.3024	0.015	0.163	0.045	0.212	19.8202 **	0	0.081
Fluorene	0	0	0.02	0	0	20.8549	0	0
Indeno (1,2,3-cd)Pyrene	0.1016	0	0	0	0.064	1.4995 **	0	0
N-Nitrosodiphenylamine	0.3191	10.7783 **	70.1037 *	2.75	0.3	1	2.8	0.55
Naphthalene	0.066	0	0.013	0	0	26.8656	0	0
Phenanthrene	0.2106	0.011	0.128	0	0.16	50.191 *	0	0.14
Phenol	0.069	0	0	0	0	2.4	0	0
Pyrene	0.2327	0.015	0.161	0	0.16	16.1793 *	0	0.085
bis(2-EthylHexyl)phthalate	1.06	1833.81 *	1.873	3.3	1.515	10.2296	200 *	27 **
Pesticides/PCBs (mg/Kg)		0						
4,4'-DDD	0.0218	0	0.0007	0.0026	0.0005	0.0043	0	0
4,4'-DDE	0.0234	0.0026	0.001	0.0019	0.0026	0.0037	0	0.0037
4,4'-DDT	0.1348	0.0124	0.0067	0.0048	0.0104	0.0082	0.8663 **	0.0016
Aldrin	0	0	0	0.0009	0.003	0.001	0	0.0001
Alpha-BHC	0	0.0741	0	0.0033	0	0.0011	0.0058	0

TABLE 9
IDENTIFICATION OF POTENTIAL HOT SPOTS - SURFACE SOIL

Olin Corporation
Wilmington, MA Facility

	Potential Hot Spots							
	Area with Buildings [2]				Area without Buildings [3]			
OHM [1]	Non-hot spot	SWMU 27	Lake Poly	Drum Area A	Non-hot spot	Area 8	SWMU 30	SWMU 33
Alpha-Chlordane	0	0.0002	0.0026	0.0041	0.0003	0.009 **	0	0
Beta-BHC	0	0	0	0	0	0.0001	0	0
Delta-BHC	0	0	0	0	0	0.0015	0	0
Dieldrin	0	0.0008	0	0.0044	0.001	0.004	0	0.0006
Endosulfan I	0	0	0	0.0052	0.0021	0.0064	0	0
Endosulfan II	0	0.0322	0	0	0	0	0.1863	0
Endrin	0	0	0.0004	0	0.0072	0	0	0
Endrin Aldehyde	0	0.0006	0	0	0	0	0	0
Endrin Ketone	0	0	0	0.0034	0.0014	0.0031	0	0
Gamma-BHC (Lindane)	0	0.0001	0.0004	0.0041	0.0245	0.0131	0	0
Gamma-Chlordane	0	0.0003	0.0012	0.0049	0.0052	0.0003	0	0
Heptachlor	0	0	0	0.0009	0	0.0004	0	0
Heptachlor Epoxide	0	0.0001	0	0.0019	0.0004	0.0001	0	0
PCB-1016	0	0			0	0	0	0.98
Metals (mg/Kg)								
Aluminum	5642.86	5190	4055	9230	4826.67	3671.25	5190	34145
Antimony	0	25.9167	1.025	1.2	0	1.3	27.325	39.75
Arsenic	10.7571	4.2	4.0667	20.3	8.0333	6.5313	8.7	11.35
Barium	26.8571	14.8	10.5667	32.75	13.9167	10.85	32.35	13.2
Beryllium	0	0	0.2092	0.465	0	0	0	2.0625
Cadmium	0.6143	0	0	0	0	0	0	2.9625
Calcium	1668.57	229.7	444.167	1955	627.183	9826.75 **	454	738.7
Chromium	28.2571	1661 **	90.3167	32.15	63.6286	254.791	1900 **	2503.05 **
Cobalt	2.9929	1.2867	1.9833	7.6	2.5417	1.4094	2.7	22.9
Copper	14.7143	10.3333	7.2833	15.7	8.25	4.325	20.6	17.35
Cyanide	0	0			0	0	7.5	5.2
Iron	8528.57	4870	5253.33	12390	6990	5596.25	10120	53210

TABLE 9
IDENTIFICATION OF POTENTIAL HOT SPOTS - SURFACE SOIL

Olin Corporation
Wilmington, MA Facility

OHM [1]	Potential Hot Spots: Area with Buildings [2]				Potential Hot Spots: Area without Buildings [3]			
	Non-hot spot	SWMU 27	Lake Poly	Drum Area A	Non-hot spot	Area 8	SWMU 30	SWMU 33
Lead	49.2857	33.5	37.8167	13.2	52.7667	15.2	31.1	34.75
Magnesium	1815.71	602.133	1040.83	3400	572	515.5	650	373.5
Manganese	90.5714	21.5667	52.5667	230	109.15	33.7875	30.65	74.7
Mercury	0.0714	0.9767 **	0.105	0.0775	0.0842	0.1495	1.675 **	0.225
Nickel	9.7571	5.3	5.6	20.15	4.1	3.295	7.4	34.75
Potassium	698.571	194.333	297	1246	215.383	164.25	174	108.7
Selenium	0.645	0	0.9517	0.98	0.5175	0.8581	1.005	0
Sodium	49.2857	59.9	99.4667	152.5	62.1	86.925	278.5	364.95
Thallium	0.3721	0	1.4167	1.8	0.885	0.8288	0	0
Vanadium	20	14.6667	8.1333	18.1	14.8333	10.325	16.9	24
Zinc	56.7143	25.2	35.2667	50.1	22.5167	16.15	20.15	92.8
Inorganics (mg/Kg)								
Chloride	26.8571	0			52.5	110	250	560 **
Nitrogen, Ammonia	19.7143	670 **	44.2667	70.2	99	163.908	400	300
Sulfate as SO4	17.6857	82	0	1285 **	4048.6	7253.16	1200	2400

Notes:

1 OHM are those detected in surface soil at the facility; see Attachment 1 for sample locations included.

2 Potential hot spots in portion of the facility containing buildings; data presented are the lesser of the maximum detected concentration or arithmetic mean concentration (calculated using 1/2 the detection limit as the value for non-detects) of samples included in the potential hot spot.

3 Potential hot spots in portion of the facility not containing buildings; data presented are the lesser of the maximum detected concentration or arithmetic mean concentration (calculated using 1/2 tthe detection limit as the value for non-detects) of samples included in the potential hot spot.

* = Concentration in potential hot spot exceeds concentration in non-hot spot area by at least 100 times.

** = Concentration in potential hot spot exceeds concentration in non-hot spot area by at least 10 times.

OHM = Oil and/or Hazardous Material

"0" indicates that OHM was not detected in samples collected at exposure point. "Blank" indicates that OHM was not analyzed for or data were rejected.

TABLE 10
IDENTIFICATION OF POTENTIAL HOT SPOTS - SUBSURFACE SOIL

Olin Corporation
Wilmington, MA Facility

OHM [1]	Potential Hot Spots [2]					
	Non-hot spot	Former Lagoon Area	Lake Poly	Drum Area A	Drum Area B	Plant B Area
VOCs (mg/Kg)						
1,2-Dichloroethane	0	0	0.002	0.082	0	0.0108
2,4,4-Trimethyl-1-pentene	0.6929	0.3758	32.3303 **	120.52 *	0	0.7236
2,4,4-Trimethyl-2-Pentene	0.4963	0.1067	20.0941 **	31.2267 **	0	0.2576
2-Butanone (MEK)	0.0061	0.0577	0.0196	0.099 **	0.0034	0.0098
2-Hexanone	0.1843	0.061	0.007	0.9039	0	0.0378
4-Methyl-2-Pentanone (MIBK)	0.0101	0	0	0.7611 **	0.5009 **	0.0128
Acetone	0.017	1.8174 *	0.0605	1.8075 *	230.084 *	0.0286
Benzene	0.003	0.0148	0.002	0.035 **	1.267 *	0
Carbon Disulfide	0.001	0	0.0097	0.6617 *	0	0
Carbon Tetrachloride	0	0	0.003	0	0	0.0043
Chlorobenzene	0	0	0.0554	0.041	0.287	0.0063
Chloroform	0.001	0.002	0.001	0	0	0.0038
Chloromethane (Methyl Chloride)	0.0004	0	0	0	0	0
Ethylbenzene	0.1075	0	0.0729	0.215	0.107	0.002
Methylene Chloride	0	0.2094	0.0064	0.3515	0.2563	0
Styrene	0.1531	0	0.013	0	0	0
Tetrachloroethene (PCE)	0.001	0.001	0.0049	0	0	0.0039
Toluene	0.2208	0.0192	0.1347	0.579	4.3336 **	0.0091
Trichloroethene (TCE)	0.003	0.0128	0	0	0	0.0076
Xylenes, Total	0.0049	0	0.0338	0.3097 **	0.567 *	0.0233
SVOCs (mg/Kg)						
1,2,3-Trichlorobenzene	0	0	0	0	1.4	0
1,2,4-Trichlorobenzene	0	0.086	0.4539	0	0.35	0
1,2-Dichlorobenzene	0	0	0.4886	0	2.0117	0
1,3-Dichlorobenzene	0	0	0.29	0	0	0
1,4-Dichlorobenzene	0	0	0.5396	0	2.4317	0
2,4-Dimethylphenol	0	0	0	0	1.625	0

TABLE 10
IDENTIFICATION OF POTENTIAL HOT SPOTS - SUBSURFACE SOIL

Olin Corporation
Wilmington, MA Facility

OHM [1]	Potential Hot Spots [2]					
	Non-hot spot	Former Lagoon Area	Lake Poly	Drum Area A	Drum Area B	Plant B Area
2-Methylnaphthalene	0	0	0.063	0	0	0
2-Methylphenol (o-Cresol)	0	0	0	0	3.7983	0
4-Bromophenyl-phenylether	0	0	0.4825	0	0	0
4-Chlorophenyl-phenylether	0	0	0.4977	0	0	0
4-Methylphenol(p-Cresol)	0	0	0	0.038	4.2983	0
Anthracene	0	0.028	0	0	0	0
Benzo(a)Anthracene	0.048	0.08	0.052	0	0	0
Benzo(a)Pyrene	0	0.055	0	0	0	0
Benzo(b)Fluoranthene	0.049	0.084	0.049	0	0	0
Butylbenzylphthalate	0.13	0.035	0.8868	1.1	0	0
Carbazole	0.057	0.086	0	0	0	0
Chrysene	0	0	0.089	0	0	0
Di-n-butylphthalate	0	0	4.427	2.1757	0.23	0
Di-n-octylphthalate	0.31	0.073	0.1991	0.2	0.88	0.252
Dibenzofuran	0	0	0.395	0	0.3883	0
Diethylphthalate	0.057	0	0	0	0	0
Fluoranthene	0	0.16	0.082	0	0	0
Hexachlorobenzene	0	0	0.24	0	0	0
Indeno (1,2,3-cd)Pyrene	0	0	0	5.6614	0	0.486
Isophorone	0	0	0	1.6329	0	0
N-Nitroso-di-n-propylamine	0.4468	0	0	0	0	0
N-Nitrosodiphenylamine	0.3664	0.397	374.448 *	4746.14 *	1.5	0.36
Naphthalene	0	0.3925	0.3375	0.077	3.4317	0
Phenanthrene	0	0.12	0.3354	0	0	0
Phenol	0.6416	0.1	0.25	1	170.253 *	0
Pyrene	0.17	0.13	0.2	0	0	0.14
bis(2-EthylHexyl)phthalate	0.8379	4.862	903.061 *	24.2471 **	367.817 *	602 *

TABLE 10
IDENTIFICATION OF POTENTIAL HOT SPOTS - SUBSURFACE SOIL

Olin Corporation
Wilmington, MA Facility

OHM [1]	Potential Hot Spots [2]					
	Non-hot spot	Former Lagoon Area	Lake Poly	Drum Area A	Drum Area B	Plant B Area
Pesticides/PCBs (mg/Kg)						
4,4'-DDD	0	0	0.0219	0	0	0
Aldrin	0	0	0.0126	0	0	0
Alpha-BHC	0	0	0.0115	0	0	0
Alpha-Chlordane	0	0	0	1.095	0	0
Endosulfan I	0	0	0	0	0.0213	0
Endosulfan Sulfate	0	0	0.0376	0	0	0
Endrin	0	0	0.0289	0	0	0
Endrin Ketone	0	0.0204	0	0	0	0
Gamma-BHC (Lindane)	0	0.0129	0	0	0	0
Methoxychlor	0	0	0	1.095	0	0
Toxaphene	0	0	0	2.1821	0	0
Metals (mg/Kg)						
Aluminum	4890.31	7636	5218.18	0	0	3040
Antimony	0	0	9.2755	0	0	0
Arsenic	5.7318	10.2	4.0136	1.8583	0.4687	3.82
Barium	16.8645	25.66	22.2909	10.2525	2.0708	7.1
Cadmium	0.6003	1.02	0.55	0.9722	0.4344	0
Calcium	728.06	5180	794.546	10814.4 **	688.333	1814
Chromium	29.7864	46.03	2316.09 **	21.1728	1.878	5.9
Cobalt	1.9926	4.025	2.6364	1.7512	0	1.6
Copper	4.9728	12.825	8.8182	14.6183	6.0037	3.09
Cyanide	0	0	2	0	0	0
Iron	6194.34	9764	7054.55	16848.8	647.533	4000
Lead	0	10.3	11.86	0	0	0
Magnesium	1723.21	2875	1604.55	0	0	978
Manganese	71.1872	156.56	62.7273	94.3222	6.053	37.6
Mercury	0.0001	0	0.1277 *	0.0002	0.0009	0

TABLE 10
IDENTIFICATION OF POTENTIAL HOT SPOTS - SUBSURFACE SOIL

Olin Corporation
Wilmington, MA Facility

OHM [1]	Potential Hot Spots [2]					
	Non-hot spot	Former Lagoon Area	Lake Poly	Drum Area A	Drum Area B	Plant B Area
Nickel	5.1476	10.94	5.8091	9.1515	8.3347	3.975
Potassium	739.013	1263	639.091	224.002	73.4433	492
Silver	0.9167	0	0	0	0	0
Sodium	88.4625	121.1	101.182	119.778	2867.1 **	78.4
Vanadium	0	13.665	13.2818	7.8444	11.674	4.91
Zinc	0	27.925	31.8364	0	0	11.9
Inorganics (mg/Kg)						
Chloride	44.5144	47.8	34.3636	11.78	0.12	29
Nitrogen, Ammonia	45.8311	68.34	1028.45 **	0.5975	0.0735	5.5
Sulfate as SO4	74.5	6199 **	65.1	3100 **	14675 *	47.6

Notes:
1 OHM are those detected in subsurface soil at the facility; see Attachment 1 for sample locations included.
2 Potential hot spots at the site; data presented are the lesser of the maximum detected concentration or the arithmetic mean concentration (calculated using 1/2 the detection limit as the value for non-detects) of samples included in the potential hot spot.
* = Concentration in potential hot spot exceeds concentration in non-hot spot area by at least 100 times.
** = Concentration in potential hot spot exceeds concentration in non-hot spot area by at least 10 times.
"0" indicates that OHM was not detected in samples collected at exposure point. "Blank" indicates that OHM was not analyzed for or data were rejected.
OHM = Oil and/or Hazardous Material

TABLE 11
IDENTIFICATION OF POTENTIAL HOT SPOTS
NON-ZONE II GROUNDWATER

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Non-hot spot	Dense Layer Hot Spot [2]		Shallow Hot Spot [2]	
VOCs (mg/L)					
1,1,1-Trichloroethane	0.002	0.0064		0.019	
1,1-Dichloroethane	0.004	0.0049		0.006	
1,1-Dichloroethene	0	0.002		0.003	
1,2-Dichloroethane	0.0025	0.0133		0	
2,4,4-Trimethyl-1-pentene	0.0263	0.0133		3.5	*
2,4,4-Trimethyl-2-Pentene	0.0114	0.0121		1.2	*
2-Butanone (MEK)	0	0.0188		0	
2-Hexanone	0	0.0345		0.009	
4-Methyl-2-Pentanone (MIBK)	0	0.004		0	
Acetone	0.4764	0.207		2	
Benzene	0	0.004		0	
Bromodichloromethane	0	0.0155		0	
Bromoform	0.0026	0.1667	**	0.022	
Carbon Disulfide	0.003	0.0194		0.009	
Carbon Tetrachloride	0.0026	0.0059		0	
Chloroform	0.0026	0.0317	**	0	
Chloromethane(MethylChloride)	0	0.006		0	
Dibromochloromethane	0	0.0439		0.007	
Ethylbenzene	0	0.0049		0	
Methylene Chloride	0.003	0.0107		0.003	
Tetrachloroethene (PCE)	0.001	0.0095		0	
Toluene	0.002	0.0366	**	0.001	
Trichloroethene (TCE)	0.0026	0.0051		0	
Xylenes, Total	0.001	0.0053		0	
SVOCs (mg/L)					
1,2,4-Trichlorobenzene	0.002	0.0047		NA	
1,2-Dichlorobenzene	0.003	0.002		NA	
1,3-Dichlorobenzene	0.001	0		NA	
1,4-Dichlorobenzene	0.003	0.003		NA	
2,4-Dichlorophenol	0	0.003		NA	
2,6-Dinitrotoluene	0.001	0.005		NA	
2-Chlorophenol	0	0.003		NA	
2-Methylphenol (o-Cresol)	0	0.0055		NA	
2-Nitrophenol	0.0051	0.082	**	NA	
4-Bromophenyl-phenylether	0.0051	0.0067		NA	
4-Chlorophenyl-phenylether	0.004	0.0053		NA	
4-Methylphenol(p-Cresol)	0	0.0189		NA	
4-Nitrophenol	0.0119	0.1177		NA	
Benzoic Acid	0.006	0.0209		NA	
Benzyl Alcohol	0.002	0.0048		NA	
Di-n-butylphthalate	0.002	0.0048		NA	
Dibenzofuran	0.002	0.002		NA	
Diethylphthalate	0.0003	0		NA	
Isophorone	0.005	0.0047		NA	

TABLE 11
IDENTIFICATION OF POTENTIAL HOT SPOTS
NON-ZONE II GROUNDWATER

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Non-hot spot	Dense Layer Hot Spot [2]		Shallow Hot Spot [2]
N-Nitrosodiphenylamine	0.0459	0.0043		NA
Naphthalene	0.001	0.0266	**	NA
Phenol	0.003	0.3474	*	NA
bis(2-EthylHexyl)phthalate	0.0048	0.0044		NA
Pesticides/PCBs (mg/L)				
Alpha-BHC	0.000027	0.0004	**	NA
Beta-BHC	0.000026	0.000079		NA
Delta-BHC	0.000029	0.00023		NA
Gamma-BHC (Lindane)	0.000027	0.000073		NA
Heptachlor Epoxide	0.000028	0.000051		NA
Metals (mg/L)				
Aluminum	2.566	1036.6	*	NA
Barium	0.0368	0.086		NA
Beryllium	0	0.0458		NA
Cadmium	0	0.106		NA
Calcium	197.4	378		NA
Chromium	0.1608	751.2267	*	NA
Cobalt	0.021	1.66	**	NA
Copper	0.36	1.465		NA
Cyanide	0.053	0.018		NA
Iron	4.3185	1448	*	NA
Lead	0	0.0914		NA
Magnesium	23.9	685.2	**	NA
Manganese	3.0302	205.8	**	NA
Mercury	0	0.0005		NA
Nickel	0.11	2.195	**	NA
Potassium	9.3	57		NA
Sodium	315.4	10880	**	NA
Vanadium	0	0.75		NA
Zinc	0.065	7.12	*	NA
Inorganics (mg/L)				
Chloride	164.5874	13316.7742	**	NA
Nitrate as N	1.2625	14.42	**	NA
Nitrite as N	0	0.1763		NA
Nitrogen, Ammonia	91.3237	1542.0089	**	220
Sulfate as SO4	681.2292	39853.125	**	NA

Notes:
1 OHM of concern are those OHM in shallow non-zone II groundwater at the facility; see Attachment 1 for sample locations included.
2 Potential hot spots at the site; data presented are the lesser of the maximum detected concentration or the arithmetic mean concentration (calculated using 1/2 the detection limit as the value for non-detects) of samples included in the potential hot spot.
The data for the shallow hot spot represent the EPC (maximum detected concentration).
* = Concentration in potential hot spot exceeds concentration in non-hot spot area by at least 100 times.

TABLE 11
IDENTIFICATION OF POTENTIAL HOT SPOTS
NON-ZONE II GROUNDWATER

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Non-hot spot	Dense Layer Hot Spot [2]	Shallow Hot Spot [2]

** = Concentration in potential hot spot exceeds concentration in non-hot spot area by at least 10 times.

"0" indicates that OHM was not detected in samples collected at exposure point. "Blank" indicates that OHM was not analyzed for or data were rejected.

OHM = Oil and/or Hazardous Material

NA = Not Applicable; VOCs were the only OHM of concern at this exposure point.

TABLE 12
IDENTIFICATION OF POTENTIAL HOT SPOTS
ZONE II GROUNDWATER

Olin Corporation
Wilmington, MA Facility

OHM of Concern[1]	Non-hot spot	Dense Layer Hot Spot [2]		Plant B Hot Spot [2]	
VOCs (mg/L)					
1,2-Dichloroethane	0.004	0.02		0	
1,2-Dichloroethene(total)	0.43	0.093		0	
2,4,4-Trimethyl-1-Pentene	0.012	0.002		0.56	**
2,4,4-Trimethyl-2-Pentene	0.006	0		0.16	**
2-Butanone (MEK)	0	0.027		0	
2-Hexanone	0.12	0		2	**
4-Methyl-2-Pentanone (MIBK)	0.003	0.003		0	
Acetone	0.076	0.37		0.66	
Benzene	0.005	0.011		0	
Bromodichloromethane	0	0.002		0	
Bromoform	0	0.014		0	
Carbon Disulfide	0.001	0.015	**	0	
Chlorobenzene	0.001	0.001		0	
Chloroform	0	0.079		0	
Dibromochloromethane	0	0.003		0	
Ethylbenzene	0.004	0.007		0.047	**
Methylene Chloride	0.002	0.02		0.006	
Tetrachloroethene (PCE)	0.004	0.004		0	
Toluene	0.17	0.17		0.018	
Trichloroethene (TCE)	0.24	0.46		0	
Vinyl chloride	0.002	0.013		0	
Xylenes, Total	0.017	0.01		0.039	
cis-1,2-Dichloroethene	0.033	0		0	
trans-1,2-Dichloroethene	0.0003	0		0	
SVOCs (mg/L)					
1,2-Dichlorobenzene	0	0.001		0.001	
1,4-Dichlorobenzene	0.001	0.002		0.002	
2,4-Dichlorophenol	0	0.003		0	
2-Chlorophenol	0	0.001		0	
2-Methylphenol (o-Cresol)	0	0.017		0	
2-Nitrophenol	0	0.045		0	
4-Chloroaniline	0	0		0.01	
4-Methylphenol(p-Cresol)	0	0.051		0.012	
4-Nitrophenol	0.004	0.11	**	0.006	
Benzoic Acid	0.003	0.041	**	0.003	
Benzyl Alcohol	0	0.006		0	
Di-n-butylphthalate	0.0009	0.0003		0.006	
Di-n-octylphthalate [3]	0.0003	0.001		6.4	*
Dibenzofuran	0	0		0.002	
Diethylphthalate	0.005	0.0004		0.011	
Fluorene	0	0		0.019	
Indeno (1,2,3-cd) pyrene	0	0		1.4	

TABLE 12
IDENTIFICATION OF POTENTIAL HOT SPOTS
ZONE II GROUNDWATER

Olin Corporation
Wilmington, MA Facility

OHM of Concern[1]	Non-hot spot	Dense Layer Hot Spot [2]		Plant B Hot Spot [2]	
N-Nitrosodiphenylamine	0.011	0		14	*
Naphthalene	0.002	0.015		0.046	**
Phenol	0	1.2		0.005	
bis(2-EthylHexyl)phthalate	0.012	0.0002		190	*
Pesticides/PCBs (mg/L)					
Aldrin	0	0		0.000077	
Alpha-BHC	0	0.000073		0	
Heptachlor epoxide	0	0		0.000013	
Gamma-BHC (Lindane)	0	0		0.000099	
Metals (mg/L)					
Aluminum	33	990	**	0.36	
Arsenic	0.084	0.008		0.035	
Barium	0.28	0.019		0.019	
Calcium	22	470	**	14	
Chromium	0.15	790	*	0.018	
Cobalt	0.089	0		0	
Copper	0.23	0		0.033	
Iron	69	1800	**	17	
Lead	0.051	0.1		0	
Magnesium	10	750	**	2.9	
Manganese	2	150	**	0.53	
Mercury	0	0		0.0003	
Nickel	0.13	0		0	
Potassium	8.1	110	**	2.7	
Sodium	78	10000	*	25	
Vanadium	0.15	0		0	
Zinc	22	0		0.43	
Inorganics (mg/L)					
Chloride	1100	12000	**	60	
Nitrate as N	2.1	24	**	0	
Nitrite as N	0.05	0.17		0	
Nitrogen, Ammonia	630	4100		380	
Sulfate as SO4	3370	48000	**	180	

Notes:

1 OHM of concern are those OHM in Zone II groundwater at the site; see Attachment 1 for sample locations included.

2 Potential hot spots at the site; data presented are the EPC (maximum detected concentration).

3 Di-n-octylphthalate was not retained as an OHM of concern, but was detected in the Plant B extraction wells at a concentration suggestive of a potential hot spot.

* = Concentration in potential hot spot exceeds concentration in non-hot spot area by at least 100 times.

TABLE 12
IDENTIFICATION OF POTENTIAL HOT SPOTS
ZONE II GROUNDWATER

Olin Corporation
Wilmington, MA Facility

OHM of Concern[1]	Non-hot spot	Dense Layer Hot Spot [2]	Plant B Hot Spot [2]

** = Concentration in potential hot spot exceeds concentration in non-hot spot area by at least 10 times.
"0" indicates that OHM was not detected in samples collected at exposure point. "Blank" indicates that OHM was not analyzed for or data were rejected.
OHM = Oil and/or Hazardous Material
NA = Not Analyzed.

TABLE 13
IDENTIFICATION OF POTENTIAL HOT SPOTS - SURFACE WATER

Olin Corporation
Wilmington, MA Facility

OHM [1]	Non-hot spot	Potential Hot Spot [2]	
VOCs (mg/L)			
1,1,1-Trichloroethane	0.0032	0.001	
1,1-Dichloroethane	0.0024	0	
1,2-Dichloroethene(total)	0	0.0033	
2,4,4-Trimethyl-1-pentene	0.0088	0.0164	
2,4,4-Trimethyl-2-Pentene	0.0051	0.0078	
2-Butanone (MEK)	0	0.0078	
4-Methyl-2-Pentanone (MIBK)	0	0.002	
Acetone	0	0.0096	
Bromoform	0	0.0023	
Chloroethane	0.0061	0.002	
Dibromochloromethane	0	0.001	
Ethylbenzene	0.0024	0.001	
Methylene Chloride	0.003	0.003	
Toluene	0.0057	0.0155	
Trichloroethene (TCE)	0.001	0.0042	
Vinyl Chloride	0	0.002	
Xylenes, Total	0.0031	0.0028	
SVOCs (mg/L)			
1,2,4-Trichlorobenzene	0	0.002	
1,4-Dichlorobenzene	0	0.002	
2-Methylphenol (o-Cresol)	0	0.001	
4-Nitrophenol	0	0.003	
Benzo(a)Pyrene	0	0.001	
Di-n-butylphthalate	0	0.001	
Di-n-octylphthalate	0.0051	0.0048	
N-Nitrosodiphenylamine	0	0.0053	
Phenol	0.001	0.003	
bis(2-EthylHexyl)phthalate	0.0046	0.0165	
Pesticides/PCBs (mg/L)			
Heptachlor Epoxide	0	0.0001	
Metals (mg/L)			
Aluminum	4.6525	4.7145	
Arsenic	0.0351	0.0063	
Barium	0.0289	0.0226	
Calcium	40.375	30.445	
Chromium	0.0315	0.9314	**
Cobalt	0.0091	0.0156	
Copper	0	0.0179	
Hexavalent Chromium		0.0374	
Iron	10.3688	3.6234	
Lead	0.0247	0.0059	
Magnesium	3.075	6.2	
Manganese	0.4696	1.0112	
Mercury	0.0002	0	
Nickel	0	0.026	
Potassium	2.0338	2.98	
Sodium	53.75	114.75	
Vanadium	0.0347	0	
Zinc	0.0552	0.0765	
Inorganics (mg/L)			
Chloride	60.625	127.45	
Nitrate as N		3.7583	
Nitrite as N		0.0609	
Nitrogen, Ammonia	3.4688	37.023	**
Sulfate as SO4	150.25	271.35	

Notes:
1 OHM are those detected in surface water at the facility; see Attachment 1 for sample locations included.
2 Potential hot spot at the site; data presented are the lesser of the maximum detected concentration or the arithmetic mean concentration (calculated using 1/2 the detection limit as the value for non-detects) of samples included in the potential hot spot.

TABLE 13
IDENTIFICATION OF POTENTIAL HOT SPOTS - SURFACE WATER

Olin Corporation
Wilmington, MA Facility

OHM [1]	Non-hot spot	Potential Hot Spot [2]

* = Concentration in potential hot spot exceeds concentration in non-hot spot area by at least 100 times.

** = Concentration in potential hot spot exceeds concentration in non-hot spot area by at least 10 times.

"0" indicates that OHM was not detected in samples collected at exposure point. "Blank" indicates that OHM was not analyzed for or data were rejected.

OHM = Oil and/or Hazardous Material

TABLE 14
IDENTIFICATION OF POTENTIAL HOT SPOTS - SEDIMENT

Olin Corporation
Wilmington, MA Facility

OHM [1]	Non-hot spot	Potential Hot Spot [2]	
VOCs (mg/Kg)			
1,1,1-Trichloroethane	0	1.3638	
1,1,2,2-Tetrachloroethane	0.0054	0.004	
1,1-Dichloroethane	0.0061	0.0215	
1,1-Dichloroethene	0	0.003	
1,2-Dichloroethane	0	0.004	
1,2-Dichloroethene(total)	0	0.0252	
1,2-Dichloropropane	0	0.022	
2,4,4-Trimethyl-1-pentene	0.0106	2.1672	*
2,4,4-Trimethyl-2-Pentene	0.0088	0.6886	**
2-Butanone (MEK)	0.019	0.0755	
2-Hexanone	0	0.036	
Acetone	0.1149	0.1963	
Benzene	0	0.018	
Bromodichloromethane	0	0.0065	
Bromoform	0	0.0266	
Carbon Disulfide	0	0.005	
Carbon Tetrachloride	0	0.011	
Chlorobenzene	0	0.014	
Chloroform	0	0.009	
Dibromochloromethane	0	0.0225	
Ethylbenzene	0	0.0312	
Methylene Chloride	0.0099	0.022	
Styrene	0	0.007	
Tetrachloroethene (PCE)	0	0.0218	
Toluene	0.0045	0.0538	**
Trichloroethene (TCE)	0.0053	0.0275	
Vinyl Chloride	0	0.012	
Xylenes, Total	0.004	0.0293	
bis(Chloromethyl)ether		0.41	
SVOCs (mg/Kg)			
1,2,4-Trichlorobenzene	0	1.4	
1,2-Dichlorobenzene	0	1.6	
2-Methylnaphthalene	0.067	1.4	**
4-Bromophenyl-phenylether	0.23	3.4	**
4-Chlorophenyl-phenylether	0.22	2.3	**
4-Methylphenol(p-Cresol)	0	0.72	
Acenaphthene	0.25	0	
Acenaphthylene	0	0.021	
Anthracene	0.2732	0.17	
Benzo(a)Anthracene	0.4825	2.1	
Benzo(a)Pyrene	0.5122	0.65	
Benzo(b)Fluoranthene	0.8876	1.2	
Benzo(g,h,i)Perylene	0.4929	0.58	
Benzo(k)Fluoranthene	0.3949	0.41	
Benzoic Acid	1.4479	3.4	
Benzyl Alcohol	0	0.27	
Butylbenzylphthalate	0	51.8965	
Chrysene	0.7577	1.3	
Di-n-butylphthalate	0.23	116.6124	*
Di-n-octylphthalate	0.3712	24	**
Dibenzo(a,h)Anthracene	0.2771	0.12	
Dibenzofuran	0.22	5.9	**
Diethylphthalate	0	0.79	
Dimethylphthalate	0	0.53	
Fluoranthene	1.1294	4.1	
Fluorene	0.3	4	**
Indeno (1,2,3-cd)Pyrene	0.5181	13	**
N-Nitrosodiphenylamine	0.3284	298.6483	*
Naphthalene	3.2598	2.2	
Nitrobenzene	0	0.067	
Phenanthrene	0.6342	34	**
Phenol	0	31.0714	
Pyrene	0.8725	9.1	**
bis(2-EthylHexyl)phthalate	37.0555	8303.3685	*

TABLE 14
IDENTIFICATION OF POTENTIAL HOT SPOTS - SEDIMENT

Olin Corporation
Wilmington, MA Facility

OHM [1]	Non-hot spot	Potential Hot Spot [2]	
Pesticides/PCBs (mg/Kg)			
4,4'-DDD	0	0.0653	
4,4'-DDT	0.018	0.086	
Aldrin	0	0.0439	
Alpha-BHC	0	0.0052	
Alpha-Chlordane	0	0.2669	
Beta-BHC	0	0.045	
Delta-BHC	0	0.0371	
Dieldrin	0.0072	0	
Endosulfan I	0.0081	0.0438	
Endosulfan Sulfate	0	0.0765	
Endrin	0	0.0694	
Endrin Aldehyde	0.4023	0.1321	
Endrin Ketone	0	0.0685	
Gamma-Chlordane	0.03	0.2691	
Heptachlor	0	0.042	
Heptachlor Epoxide	0.005	0.0366	
Methoxychlor	0	0.29	
Metals (mg/Kg)			
Aluminum	5839.4118	13582.0619	
Antimony	0	33.5297	
Arsenic	30.6265	35.7893	
Barium	18.4647	31.6862	
Beryllium	0	1.0864	
Cadmium	1.0765	1.2081	
Calcium	1005.8824	1482.6738	
Chromium	56.5882	1826.5595	**
Cobalt	4.9765	6.8764	
Copper	31.6059	36.0358	
Hexavalent Chromium		0.1135	
Iron	21166.4706	18142.531	
Lead	16.0313	56.8788	
Magnesium	1024.2353	962.8386	
Manganese	165.3824	130.5822	
Mercury	0.0956	0.2891	
Nickel	5.8029	12.5906	
Potassium	518.2353	429.6605	
Selenium	0.6994	0	
Silver	1.3	0.9364	
Sodium	91.3529	276.5671	
Thallium	0	0.6323	
Vanadium	16.0088	16.2636	
Zinc	40.4382	109.7075	
Inorganics (mg/Kg)			
Chloride	30.2353	166.6087	
Nitrate as N		1.8218	
Nitrite as N		0.7001	
Nitrogen, Ammonia	38.5882	174.099	
Sulfate as SO4	665.2941	1597.6765	

Notes:
1 OHM are those detected in sediment at the facility; see Attachment 1 for sample locations included.
2 Potential hot spot at the site (historical data from ditches); data presented are the lesser of the maximum detected concentration or the arithmetic mean concentration (calculated using 1/2 the detection limit as the value for non-detects) of samples included in the potential hot spot.
* = Concentration in potential hot spot exceeds concentration in non-hot spot area by at least 100 times.
** = Concentration in potential hot spot exceeds concentration in non-hot spot area by at least 10 times.
"0" indicates that OHM was not detected in samples collected at exposure point. "Blank" indicates that OHM was not analyzed for or data were rejected.
OHM = Oil and/or Hazardous Material

TABLE 15
CONFIRMED HOT SPOTS

Olin Corporation
Wilmington, MA Facility

Medium	Hot Spot Name / Hot Spot Analytes					
Surface Soil	**Area 8 Hot Spot** Acenaphthylene Anthracene Benzo(a)Anthracene Benzo(a)Pyrene Benzo(b)Fluoranthene Benzo(k)Fluoranthene Chrysene Fluoranthene Indeno(1,2,3-cd)Pyrene Phenanthrene Pyrene Di-n-butylphthalate Alpha Chlordane Calcium	**Drum Area A Hot Spot** Sulfate	**Lake Poly Hot Spot** N-Nitrosodiphenylamine	**SWMU-27 Hot Spot** Tetrachloroethylene Di-n-butylphthalate Di-n-octylphthalate N-Nitrosodiphenylamine bis (2-EthylHexyl)Phthalate Chromium Mercury Nitrogen, Ammonia	**SWMU-30 Hot Spot** bis (2-EthylHexyl)Phthalate 4,4'-DDT Chromium Mercury	**SWMU-33 Hot Spot** bis (2-EthylHexyl)Phthalate Chromium Chloride
Subsurface Soil	**Drum Area B Hot Spot** Acetone Xylenes, total bis (2-EthylHexyl)Phthalate Sulfate 4-Methyl-2-Pentanone Benzene Toluene Phenol Sodium	**Drum Area A Hot Spot** 2,4,4-Trimethyl-1-pentene 2,4,4-Trimethyl-2-pentene 2-Butanone 4-Methyl-2-Pentanone Acetone Benzene Carbon Disulfide Xylenes, total N-Nitrosodiphenylamine bis (2-EthylHexyl)Phthalate Calcium Sulfate	**Lake Poly Hot Spot** 2,4,4-Trimethyl-1-pentene 2,4,4-Trimethyl-2-pentene N-Nitrosodiphenylamine bis (2-EthylHexyl)Phthalate Chromium Mercury Nitrogen, Ammonia	**Former Lagooon Area Hot Spot** Acetone Sulfate	**Plant B Area Hot Spot** bis (2-EthylHexyl)Phthalate	
Surface Water	**Ditches (Historical Data)** Chromium Nitrogen, Ammonia					

TABLE 15
CONFIRMED HOT SPOTS

Olin Corporation
Wilmington, MA Facility

Medium	Hot Spot Name / Hot Spot Analytes					
Sediment	**Ditches** 2,4,4-Trimethyl-1-pentene 2,4,4-Trimethyl-2-pentene Toluene 2-Methylnaphthalene Dibenzofuran Fluorene Indeno(1,2,3-cd)Pyrene Phenanthrene Pyrene 4-Bromophenyl-phenylether 4-Chlorophenyl-phenylether Di-n-butylphthalate Di-n-octylphthalate bis (2-EthylHexyl)Phthalate N-Nitrosodiphenylamine Chromium					
Non-Zone II Groundwater	**Shallow Hot Spot** 2,4,4-Trimethyl-1-pentene 2,4,4-Trimethyl-2-pentene	**Dense Layer Hot Spot** Phenol Aluminum Chromium Iron Magnesium Manganese Sodium Chloride Nitrogen, Ammonia Sulfate Bromoform Naphthalene Chloroform Toluene 2-Nitrophenol Alpha-BHC Cobalt Nickel Zinc Nitrate				
Zone II Groundwater	**Plant B Hot Spot** N-Nitrosodiphenylamine bis(2-ethylhexyl)phthalate 2,4,4-Trimethyl-1-pentene 2,4,4-Trimethyl-2-pentene 2-Hexanone Ethyl Benzene Di-n-octylphthalate Naphthalene	**Dense Layer Hot Spot** 4-Nitrophenol Calcium Iron Carbon Disulfide Benzoic Acid Aluminum Chromium Magnesium Manganese Potassium Sodium Chloride Nitrate Sulfate				

TABLE 16
EXPOSURE POINTS

Olin Corporation
Wilmington, MA Facility

Human Health Exposure Point Number	Human Health Exposure Point Name
SURFACE SOIL	
1	Area 8 Hot Spot
2	Drum Area A Hot Spot
3	Lake Poly Hot Spot
4	Area without buildings (excluding hot spots)
5	Sulfate Landfill
6	SWMU-27 Hot Spot
7	SWMU-30 Hot Spot
8	SWMU-33 Hot Spot
9	Area with buildings (excluding hot spots)
SUBSURFACE SOIL	
11	Lake Poly Hot Spot
12	Drum Area B Hot Spot
13	Drum Area A Hot Spot
14	Former Lagoon Area Hot Spot
15	Plant B Area Hot Spot
16	Sulfate Landfill
17	Site Area (excluding hot spots and sulfate landfill)

TABLE 16
EXPOSURE POINTS

Olin Corporation
Wilmington, MA Facility

Human Health Exposure Point Number	Human Health Exposure Point Name
GROUNDWATER	
101	Non-Zone II, shallow groundwater hot spot
102	Zone II, Plant B area hot spot
107	Non-Zone II, excluding hot spots
105	Zone II, dense layer plume hot spot
108	Non-Zone II, dense layer groundwater hot spot
106	Zone II, excluding hot spots
SURFACE WATER	
19	East Ditch Current, Recent Data
20	On-Site Ditch Current, Recent Data
21	West Ditch Off-Site Current, Recent Data
22	East Ditch Current, Historical Data
23	On-Site Ditch Current, Historical Data
24	West Ditch Current, Historical Data
27	Hot Spot Future, Historical Data
28	Non-Hot Spot Future, Historical Data

TABLE 16
EXPOSURE POINTS

Olin Corporation
Wilmington, MA Facility

Human Health Exposure Point Number	Human Health Exposure Point Name
SEDIMENT	
30	East Ditch Current
31	On-Site Ditch Current
32	West Ditch Off-Site Current
34	Hot Spot Future
35	Non- Hot Spot Future

TABLE 17
EXPOSURE PROFILES

Olin Corporation
Wilmington, MA Facility

RECEPTOR	EXPOSURE POINT	EXPOSURE MEDIUM AND ROUTE	FREQUENCY	DURATION	
CURRENT LAND USE **Neighborhood Resident** (7 through 16 years of age)	**Off-Site** (Ditches east or west of site)	**Surface Water** Ingestion	2 events/month June through August	10 years	2 hours/event
		Dermal Contact	2 events/month June through August	10 years	2 hours/event
	Off-Site (Ditches east or west of site)	**Sediment** Ingestion	2 events/month June through August	10 years	1 day/event
		Dermal Contact	2 events/month June through August	10 years	1 day/event
On-Site Worker (full-time, long-term industrial worker)	**On-Site**	**Surface Soil** Ingestion	3 event/year 12 hours/event (@ 2 hours/day)	25 years	6 days/event
		Dermal Contact	3 event/year 12 hours/event (@ 2 hours/day)	25 years	6 days/event
		Inhalation of Dust	18 days/year	25 years	2 hours/day
	On-Site Ditches	**Surface Water** Ingestion	3 events/year	25 years	4 hours/event
		Dermal Contact	3 events/year	25 years	4 hours/event
	On-Site Ditches	**Sediment** Ingestion	3 events/year @4 hours/event	25 years	1 day/event
		Dermal Contact	3 events/year @4 hours/event	25 years	1 day/event

TABLE 17
EXPOSURE PROFILES

Olin Corporation

Wilmington, MA Facility

RECEPTOR	EXPOSURE POINT	EXPOSURE MEDIUM AND ROUTE	FREQUENCY	DURATION	
Utility Worker	On-Site	Surface and Subsurface Soil			
		Ingestion	5 events/week for 2 weeks	2 weeks	1 day/event
		Dermal Contact	5 events/week for 2 weeks	2 weeks	1 day/event
		Inhalation of dust	5 events/week for 2 weeks	2 weeks	8 hours/event
Off-Site Worker	Surrounding Facilities	Process Water (Groundwater)			
		Inhalation of Vapors	5 events/week 50 weeks/year	25 years	8 hours/event
		Dermal Contact	5 events/week 50 weeks/year	25 years	2 hours/event
		Indoor Air			
		Inhalation of vapors migrating from groundwater	5 events/week 50 weeks/year	25 years	8 hours/event

TABLE 17
EXPOSURE PROFILES

Olin Corporation
Wilmington, MA Facility

RECEPTOR	EXPOSURE POINT	EXPOSURE MEDIUM AND ROUTE	FREQUENCY	DURATION	
FUTURE LAND USE					
Neighborhood Resident	**Public Supply Wells** [1]	**Groundwater**			
		Ingestion	350 days/year	30 years	1 event/day
(7 through 16 years of age)		Dermal Contact	350 days/year	30 years	0.2 hours/day
		Inhalation of Volatiles	350 days/year	30 years	0.2 hours/day
	On- and Off-Site Ditches	**Surface Water**			
		Ingestion	2 events/month June through August	10 years	2 hours/event
		Dermal Contact	2 events/month June through August	10 years	2 hours/event
	On- and Off-Site Ditches	**Sediment**			
		Ingestion	2 events/month June through August	10 years	1 day/event
		Dermal Contact	2 events/month June through August	10 years	1 day/event
	On-Site	**Surface Soil**			
		Ingestion	2 events/month May through October	10 years	1 day/event
		Dermal Contact	2 events/month May through October	10 years	1 day/event
On-Site Worker	**On-Site**	**Surface Soil**			
		Ingestion	153 events/year	25 years	1 day/event
		Dermal Contact	153 events/year	25 years	1 day/event
	Public Supply Wells [1]	**Groundwater**			
		Ingestion	5 events/week 50 weeks/year	25 years	1 day/event
	On-Site Ditches	**Surface Water**			
		Ingestion	3 events/year	25 years	4 hours/event
		Dermal Contact	3 events/year	25 years	4 hours/event

TABLE 17
EXPOSURE PROFILES

Olin Corporation

Wilmington, MA Facility

RECEPTOR	EXPOSURE POINT	EXPOSURE MEDIUM AND ROUTE	FREQUENCY	DURATION	
On-Site Worker (cont)					
	On-Site Ditches	**Sediment**			
		Ingestion	3 events/year @4 hours/event	25 years	1 day/event
		Dermal Contact	3 events/year @4 hours/event	25 years	1 day/event
		Inhalation of Dust	153 events/year	25 years	8 hours/event
	On-Site Building	**Indoor Air**			
		Inhalation of vapors migrating from groundwater	5 days/week 50 weeks/year	25 years	8 hours/event
Utility Worker	**On-Site**	**Surface and Subsurface Soil**			
		Ingestion	5 events/week for 2 weeks	2 weeks	1 day/event
		Dermal Contact	5 events/week for 2 weeks	2 weeks	1 day/event
		Inhalation of dust	5 events/week for 2 weeks	2 weeks	8 hours/event
Construction Worker	**On-Site**	**Surface and Subsurface Soil**			
		Ingestion	5 events/week for 8 weeks	2 months	1 day/event
		Dermal Contact	5 events/week for 8 weeks	2 months	1 day/event
		Inhalation of dust	5 events/week for 8 weeks	2 months	8 hours/event
Off-Site Worker	**Surrounding Facilities**	**Process Water (Groundwater)**			
		Inhalation of Vapors	5 events/week 50 weeks/year	25 years	8 hours/event
		Dermal Contact	5 events/week 50 weeks/year	25 years	2 hours/event
		Indoor Air			
		Inhalation of vapors migrating from groundwater	5 events/week 50 weeks/year	25 years	8 hours/event
	Public Supply Wells [1]	**Groundwater**			
		Ingestion	5 events/week 50 weeks/year	25 years	1day/event

Notes:

[1] Any groundwater potentially impacting GW-1 groundwater either on the facility or beyond its boundaries will be evaluated as a potential contributor to contamination of public water supply wells through modelling potential contaminant migration to public water supply wells.

TABLE 18
SURFACE SOIL EXPOSURE POINT CONCENTRATIONS - AREA 8 HOT SPOT

Olin Corporation
Wilmington, MA Facility

	Site Data/Concentration [2]						
OHM of Concern [1]	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]
VOCs (mg/Kg)							
1,1,1-Trichloroethane	0.006 :	0.014	10 / 22	0.002	0.016	0.0067	0.0067
2,4,4-Trimethyl-1-pentene	0.005 :	0.013	5 / 22	0.0008	0.014	0.0043	0.0043
2-Butanone (MEK)	0.011 :	0.028	2 / 22	0.001	0.004	0.0071	0.004
Acetone	0.013 :	0.021	20 / 22	0.006	0.061	0.0208	0.0208
Methylene Chloride	0.005 :	0.014	6 / 22	0.004	0.036	0.0054	0.0054
Toluene	0.005 :	0.013	3 / 22	0.0006	0.005	0.0033	0.0033
SVOCs (mg/Kg)							
2-Methylnaphthalene	0.38 :	4.3	2 / 21	0.007	560	27.0453	27.0453
2-Methylphenol (o-Cresol)	0.39 :	160	2 / 21	0.02	0.049	4.1821	0.049
Acenaphthene	0.38 :	4.3	1 / 21	170	170	8.4841	8.4841
Acenaphthylene	0.38 :	4.3	3 / 21	0.02	420	20.3667	20.3667
Anthracene	0.39 :	4.3	6 / 21	0.01	290	14.1153	14.1153
Benzo(a)Anthracene	0.39 :	4.3	5 / 21	0.015	140	7.0161	7.0161
Benzo(a)Pyrene	0.38 :	4.3	3 / 21	0.034	100	5.1281	5.1281
Benzo(b)Fluoranthene	0.38 :	4.3	4 / 21	0.044	44	2.4527	2.4527
Benzo(g,h,i)Perylene	0.38 :	4.3	2 / 21	0.03	29	1.7607	1.7607
Benzo(k)Fluoranthene	0.38 :	4.3	4 / 21	0.025	66	3.4991	3.4991
Benzoic Acid	1.9 :	770	9 / 21	0.07	1.8	19.38	1.8
Butylbenzylphthalate	0.38 :	160	1 / 21	0.8	0.8	4.2102	0.8
Chrysene	0.39 :	4.3	5 / 21	0.015	150	7.4942	7.4942
Di-n-butylphthalate	0.44 :	160	12 / 21	0.013	1.4	4.042	1.4
Di-n-octylphthalate	0.38 :	160	2 / 21	0.012	0.17	4.1706	0.17
Dibenzofuran	0.38 :	4.3	1 / 21	39	39	2.246	2.246
Diethylphthalate	0.38 :	160	6 / 21	0.015	0.053	4.1075	0.053
Fluoranthene	0.39 :	4.3	8 / 21	0.027	410	19.8202	19.8202
Fluorene	0.38 :	4.3	2 / 21	0.008	430	20.8549	20.8549
Indeno (1,2,3-cd)Pyrene	0.38 :	4.3	3 / 21	0.031	24	1.4995	1.4995
N-Nitrosodiphenylamine	0.39 :	160	3 / 20	0.26	1	4.3093	1

TABLE 18
SURFACE SOIL EXPOSURE POINT CONCENTRATIONS - AREA 8 HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]
Naphthalene	0.39 :	4.3	3 / 20	0.008	530	26.8656	26.8656
Phenanthrene	0.39 :	0.96	8 / 20	0.03	1000	50.191	50.191
Phenol	0.39 :	160	1 / 20	2.4	2.4	4.4913	2.4
Pyrene	0.39 :	0.96	9 / 20	0.024	320	16.1793	16.1793
bis(2-EthylHexyl)phthalate	0.43 :	160	16 / 21	0.0655	89	10.2296	10.2296
Pesticides/PCBs (mg/Kg)							
4,4'-DDD	0.0039 :	0.045	7 / 21	0.0002	0.017	0.0043	0.0043
4,4'-DDE	0.0039 :	0.045	11 / 21	0.0005	0.011	0.0037	0.0037
4,4'-DDT	0.0039 :	0.045	13 / 21	0.0014	0.04	0.0082	0.0082
Aldrin	0.002 :	0.022	2 / 21	0.0001	0.001	0.0018	0.001
Alpha-BHC	0.002 :	0.022	3 / 21	0.0002	0.0011	0.0019	0.0011
Alpha-Chlordane	0.002 :	0.22	3 / 21	0.0008	0.052	0.009	0.009
Dieldrin	0.0039 :	0.045	8 / 21	0.0004	0.012	0.004	0.004
Endosulfan I	0.002 :	0.022	2 / 21	0.0019	0.099	0.0064	0.0064
Endrin Ketone	0.0039 :	0.045	1 / 21	0.0031	0.0031	0.0038	0.0031
Gamma-BHC (Lindane)	0.002 :	0.022	10 / 21	0.0001	0.17	0.0131	0.0131
Gamma-Chlordane	0.002 :	0.22	1 / 21	0.0003	0.0003	0.0066	0.0003
Heptachlor	0.002 :	0.022	2 / 21	0.0003	0.0004	0.0018	0.0004
Heptachlor Epoxide	0.002 :	0.022	1 / 21	0.0001	0.0001	0.0019	0.0001
Metals (mg/Kg)							
Aluminum	0 :	0	8 / 8	1700	9100	3671.25	3671.25
Antimony	0.97 :	20	1 / 8	1.3	1.3	1.84	1.3
Arsenic	0.9 :	0.9	7 / 8	2.2	24.5	6.5313	6.5313
Barium	0 :	0	8 / 8	3.6	21	10.85	10.85
Calcium	0 :	0	8 / 8	91	53000	9826.75	9826.75
Chromium	0 :	0	21 / 21	2.6	3010	254.7905	254.791
Cobalt	0.21 :	0.21	7 / 8	0.42	3.9	1.4094	1.4094
Iron	0 :	0	8 / 8	1200	20000	5596.25	5596.25

TABLE 18
SURFACE SOIL EXPOSURE POINT CONCENTRATIONS - AREA 8 HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
Lead	0	0	8 / 8	2.3	34	15.2	15.2
Manganese	0	0	8 / 8	3.9	99.9	33.7875	33.7875
Mercury	0.089	0.12	4 / 8	0.09	0.38	0.1495	0.1495
Nickel	0	0	8 / 8	0.96	9.3	3.295	3.295
Selenium	0.9	1.1	3 / 8	1.1	2.2	0.8581	0.8581
Sodium	0	0	8 / 8	66	130	86.925	86.925
Thallium	1.4	1.7	1 / 8	0.88	0.88	0.8288	0.8288
Vanadium	0	0	8 / 8	4.8	18.4	10.325	10.325
Zinc	0	0	8 / 8	4.8	41.4	16.15	16.15
Inorganics (mg/Kg)							
Chloride	0	0	1 / 1	110	110	110	110
Nitrogen, Ammonia	0	0	19 / 19	15.65	363	163.9079	163.908
Sulfate as SO4	130	430	17 / 19	150	28000	7253.158	7253.16

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 1.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 19
SURFACE SOIL EXPOSURE POINT CONCENTRATIONS - DRUM AREA A HOT SPOT

Olin Corporation
Wilmington, MA Facility

	Site Data/Concentration [2]						
OHM of Concern [1]	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]
VOCs (mg/Kg)							
1,1,1-Trichloroethane	0.005	0.005	5 / 8	0.002	0.018	0.0068	0.0068
Acetone	0	0	8 / 8	0.006	0.021	0.012	0.012
Toluene	0.005	0.006	1 / 8	0.0009	0.0009	0.0024	0.0009
SVOCs (mg/Kg)							
Di-n-butylphthalate	0	0	2 / 2	0.13	0.2	0.165	0.165
Fluoranthene	9.1	9.1	1 / 2	0.045	0.045	2.2975	0.045
N-Nitrosodiphenylamine	0	0	2 / 2	2.7	2.8	2.75	2.75
bis(2-EthylHexyl)phthalate	0	0	2 / 2	1.3	5.3	3.3	3.3
Pesticides/PCBs (mg/Kg)							
4,4'-DDD	0	0	2 / 2	0.0017	0.0034	0.0026	0.0026
4,4'-DDE	0.0037	0.0037	1 / 2	0.0019	0.0019	0.0019	0.0019
4,4'-DDT	0	0	2 / 2	0.0031	0.0064	0.0048	0.0048
Aldrin	0	0	2 / 2	0.0005	0.0012	0.0009	0.0009
Alpha-BHC	0	0	2 / 2	0.0016	0.005	0.0033	0.0033
Alpha-Chlordane	0	0	2 / 2	0.0036	0.0045	0.0041	0.0041
Dieldrin	0.0037	0.0037	1 / 2	0.0069	0.0069	0.0044	0.0044
Endosulfan I	0	0	2 / 2	0.0047	0.0056	0.0052	0.0052
Endrin Ketone	0.0038	0.0038	1 / 2	0.0048	0.0048	0.0034	0.0034
Gamma-BHC (Lindane)	0	0	2 / 2	0.0034	0.0047	0.0041	0.0041
Gamma-Chlordane	0.0019	0.0019	1 / 2	0.0088	0.0088	0.0049	0.0049
Heptachlor	0.0019	0.0019	1 / 2	0.0009	0.0009	0.0009	0.0009
Heptachlor Epoxide	0.0019	0.0019	1 / 2	0.0028	0.0028	0.0019	0.0019
Metals (mg/Kg)							
Aluminum	0	0	2 / 2	5560	12900	9230	9230
Antimony	0	0	2 / 2	1.2	1.2	1.2	1.2
Arsenic	0	0	2 / 2	9.7	30.9	20.3	20.3
Barium	0	0	2 / 2	22.3	43.2	32.75	32.75
Beryllium	0	0	2 / 2	0.32	0.61	0.465	0.465

TABLE 19
SURFACE SOIL EXPOSURE POINT CONCENTRATIONS - DRUM AREA A HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]
	Site Data/Concentration [2]						
Calcium	0	0	2 / 2	1850	2060	1955	1955
Chromium	0	0	2 / 2	24.1	40.2	32.15	32.15
Cobalt	0	0	2 / 2	3.9	11.3	7.6	7.6
Iron	0	0	2 / 2	7580	17200	12390	12390
Lead	0	0	2 / 2	9.4	17	13.2	13.2
Manganese	0	0	2 / 2	109	351	230	230
Mercury	0.09	0.09	1 / 2	0.11	0.11	0.0775	0.0775
Nickel	0	0	2 / 2	10.2	30.1	20.15	20.15
Selenium	0	0	2 / 2	0.96	1	0.98	0.98
Sodium	0	0	2 / 2	131	174	152.5	152.5
Thallium	0	0	2 / 2	1.8	1.8	1.8	1.8
Vanadium	0	0	2 / 2	11.3	24.9	18.1	18.1
Zinc	0	0	2 / 2	37.2	63	50.1	50.1
Inorganics (mg/Kg)							
Nitrogen, Ammonia	0	0	2 / 2	47.4	93	70.2	70.2
Sulfate as SO4	0	0	2 / 2	260	2310	1285	1285

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 1.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan

TABLE 20
SURFACE SOIL EXPOSURE POINT CONCENTRATIONS - LAKE POLY HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]
VOCs (mg/Kg)							
1,1,1-Trichloroethane	0	0	3 / 3	0.003	0.011	0.0066	0.0066
2-Butanone (MEK)	0.011	0.011	1 / 3	0.004	0.004	0.005	0.004
Acetone	0	0	3 / 3	0.018	0.026	0.0212	0.0212
Methylene Chloride	0.005	0.005	1 / 3	0.002	0.002	0.0023	0.002
Toluene	0.005	0.005	2 / 3	0.0009	0.001	0.0017	0.001
SVOCs (mg/Kg)							
Acenaphthylene	0.35	37	1 / 3	0.027	0.027	6.2587	0.027
Anthracene	0.35	37	1 / 3	0.022	0.022	6.2323	0.022
Benzo(a)Anthracene	37	37	2 / 3	0.008	0.07	6.1927	0.07
Benzo(b)Fluoranthene	37	37	2 / 3	0.013	0.107	6.2067	0.107
Benzo(k)Fluoranthene	37	37	2 / 3	0.019	0.0925	6.2038	0.0925
Benzoic Acid	1.7	180	1 / 3	0.096	0.096	30.3153	0.096
Butylbenzylphthalate	0.35	37	1 / 3	0.029	0.029	6.259	0.029
Chrysene	37	37	2 / 3	0.016	0.088	6.2013	0.088
Di-n-butylphthalate	0	0	3 / 3	0.009	1	0.3512	0.3512
Di-n-octylphthalate	0.35	37	1 / 3	0.022	0.022	6.2612	0.022
Dibenzofuran	0.35	37	1 / 3	0.016	0.016	6.2568	0.016
Diethylphthalate	0.35	37	1 / 3	0.0245	0.0245	6.2332	0.0245
Fluoranthene	37	37	2 / 3	0.022	0.163	6.2283	0.163
Fluorene	0.35	37	1 / 3	0.02	0.02	6.2575	0.02
N-Nitrosodiphenylamine	0.35	0.35	2 / 3	0.097	210	70.1037	70.1037
Naphthalene	0.35	37	1 / 3	0.013	0.013	6.2563	0.013
Phenanthrene	0.35	37	1 / 3	0.128	0.128	6.2677	0.128
Pyrene	37	37	2 / 3	0.017	0.161	6.226	0.161
bis(2-EthylHexyl)phthalate	0	0	3 / 3	0.18	5.1	1.873	1.873

TABLE 20
SURFACE SOIL EXPOSURE POINT CONCENTRATIONS - LAKE POLY HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]
Pesticides/PCBs (mg/Kg)							
4,4'-DDD	0.0035 :	0.018	1 / 3	0.0007	0.0007	0.0038	0.0007
4,4'-DDE	0.0035 :	0.018	1 / 3	0.001	0.001	0.0039	0.001
4,4'-DDT	0.018 :	0.018	2 / 3	0.0023	0.0088	0.0067	0.0067
Alpha-Chlordane	0.0018 :	0.0094	1 / 3	0.0034	0.0034	0.0026	0.0026
Endrin	0.0035 :	0.018	1 / 3	0.0004	0.0004	0.0039	0.0004
Gamma-BHC (Lindane)	0.0094 :	0.0094	2 / 3	0.0001	0.0004	0.0019	0.0004
Gamma-Chlordane	0.0018 :	0.0094	1 / 3	0.0012	0.0012	0.0022	0.0012
Metals (mg/Kg)							
Aluminum	0 :	0	3 / 3	3440	4840	4055	4055
Antimony	0 :	0	3 / 3	1	1.2	1.025	1.025
Arsenic	0 :	0	3 / 3	3.9	4.2	4.0667	4.0667
Barium	0 :	0	3 / 3	6.5	12.9	10.5667	10.5667
Beryllium	0 :	0	3 / 3	0.2	0.26	0.2092	0.2092
Calcium	0 :	0	3 / 3	318	518	444.1667	444.167
Chromium	0 :	0	3 / 3	28.9	203	90.3167	90.3167
Cobalt	0 :	0	3 / 3	1.5	2.5	1.9833	1.9833
Iron	0 :	0	3 / 3	4810	5950	5253.333	5253.33
Lead	0 :	0	3 / 3	4.8	93.65	37.8167	37.8167
Manganese	0 :	0	3 / 3	39.8	60.5	52.5667	52.5667
Mercury	0.1 :	0.1	2 / 3	0.125	0.14	0.105	0.105
Nickel	0 :	0	3 / 3	5.3	6.1	5.6	5.6
Selenium	0 :	0	3 / 3	0.88	1	0.9517	0.9517
Sodium	0 :	0	3 / 3	77.4	114	99.4667	99.4667
Thallium	1.6 :	1.6	2 / 3	1.6	1.85	1.4167	1.4167
Vanadium	0 :	0	3 / 3	7.2	9	8.1333	8.1333
Zinc	0 :	0	3 / 3	27.1	43.6	35.2667	35.2667

TABLE 20
SURFACE SOIL EXPOSURE POINT CONCENTRATIONS - LAKE POLY HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
Inorganics (mg/Kg)							
Nitrogen, Ammonia	0	0	3 / 3	23.8	66.6	44.2667	44.2667

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 1.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 21
SURFACE SOIL EXPOSURE POINT CONCENTRATIONS - AREA WITHOUT BUILDINGS (EXCLUDING HOT SPOTS AND SULFATE LANDFILL)

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL : Maximum SQL		Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
VOCs (mg/Kg)							
1,1,1-Trichloroethane	0.005 :	0.01	8 / 16	0.005	0.23	0.0237	0.0237
1,1-Dichloroethene	0.005 :	0.01	1 / 16	0.018	0.018	0.0043	0.0043
Acetone	0.012 :	0.024	11 / 16	0.005	0.036	0.0153	0.0153
Methylene Chloride	0.005 :	0.041	6 / 16	0.002	0.008	0.0052	0.0052
Toluene	0.005 :	0.01	2 / 16	0.003	0.004	0.0034	0.0034
SVOCs (mg/Kg)							
Acenaphthylene	0.39 :	1.1	2 / 6	0.008	0.045	0.2213	0.045
Anthracene	0.39 :	1.1	1 / 6	0.005	0.005	0.2967	0.005
Benzo(a)Anthracene	0.39 :	1	2 / 6	0.012	0.099	0.2227	0.099
Benzo(a)Pyrene	0.39 :	1	2 / 6	0.011	0.059	0.2158	0.059
Benzo(b)Fluoranthene	0.39 :	1	2 / 6	0.013	0.18	0.2363	0.18
Benzo(k)Fluoranthene	0.39 :	1	2 / 6	0.012	0.065	0.217	0.065
Benzoic Acid	1.9 :	5.3	3 / 6	0.24	0.79	1.065	0.79
Chrysene	0.39 :	1	2 / 6	0.016	0.17	0.2352	0.17
Di-n-butylphthalate	1 :	1.1	4 / 6	0.013	0.065	0.1958	0.065
Diethylphthalate	0.58 :	1.1	3 / 6	0.013	0.044	0.235	0.044
Fluoranthene	0.39 :	1	3 / 6	0.011	0.25	0.212	0.212
Indeno (1,2,3-cd)Pyrene	0.39 :	1	1 / 6	0.064	0.064	0.2557	0.064
N-Nitrosodiphenylamine	0.39 :	1.1	1 / 6	0.3	0.3	0.3033	0.3
Phenanthrene	0.39 :	1	3 / 6	0.012	0.16	0.196	0.16
Pyrene	0.39 :	1	3 / 6	0.013	0.16	0.1963	0.16
bis(2-EthylHexyl)phthalate	0 :	0	6 / 6	0.13	5.2	1.515	1.515
Pesticides/PCBs (mg/Kg)							
4,4'-DDD	0.0038 :	0.053	3 / 7	0.0001	0.0005	0.0087	0.0005
4,4'-DDE	0.0038 :	0.053	3 / 7	0.0016	0.0026	0.0095	0.0026
4,4'-DDT	0.0038 :	0.053	4 / 7	0.0014	0.014	0.0104	0.0104

TABLE 21
SURFACE SOIL EXPOSURE POINT CONCENTRATIONS - AREA WITHOUT BUILDINGS (EXCLUDING HOT SPOTS AND SULFATE LANDFILL)

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
Aldrin	0.002 :	0.026	2 / 7	0.0019	0.003	0.0044	0.003
Alpha-Chlordane	0.002 :	0.26	1 / 7	0.0003	0.0003	0.0336	0.0003
Dieldrin	0.0038 :	0.038	2 / 7	0.0009	0.001	0.0073	0.001
Endosulfan I	0.002 :	0.026	1 / 7	0.0021	0.0021	0.0049	0.0021
Endrin	0.0038 :	0.053	1 / 7	0.0072	0.0072	0.0089	0.0072
Endrin Ketone	0.0038 :	0.053	1 / 7	0.0014	0.0014	0.0095	0.0014
Gamma-BHC (Lindane)	0.002 :	0.026	2 / 7	0.0052	0.14	0.0245	0.0245
Gamma-Chlordane	0.002 :	0.26	1 / 7	0.0052	0.0052	0.0343	0.0052
Heptachlor Epoxide	0.002 :	0.026	1 / 7	0.0004	0.0004	0.0047	0.0004
Metals (mg/Kg)							
Aluminum	0 :	0	6 / 6	2250	8000	4826.667	4826.67
Arsenic	0 :	0	6 / 6	1.2	24	8.0333	8.0333
Barium	0 :	0	6 / 6	5.3	25	13.9167	13.9167
Calcium	0 :	0	6 / 6	85.7	1200	627.1833	627.183
Chromium	0 :	0	7 / 7	3.5	320	63.6286	63.6286
Cobalt	0.24 :	0.24	5 / 6	0.43	9.9	2.5417	2.5417
Iron	0 :	0	6 / 6	2090	16000	6990	6990
Lead	0 :	0	6 / 6	2	210	52.7667	52.7667
Manganese	0 :	0	6 / 6	3.7	530	109.15	109.15
Mercury	0.11 :	0.18	2 / 6	0.11	0.12	0.0842	0.0842
Nickel	0 :	0	6 / 6	1.5	7.6	4.1	4.1
Selenium	0.5 :	1.4	1 / 6	0.91	0.91	0.5175	0.5175
Sodium	0 :	0	6 / 6	34	120	62.1	62.1
Thallium	0.52 :	2.2	2 / 6	0.8	1.4	0.885	0.885
Vanadium	0 :	0	6 / 6	4.3	34	14.8333	14.8333
Zinc	0 :	0	6 / 6	5.1	72	22.5167	22.5167

TABLE 21
SURFACE SOIL EXPOSURE POINT CONCENTRATIONS - AREA WITHOUT BUILDINGS (EXCLUDING HOT SPOTS AND SULFATE LANDFILL)

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]
	Site Data/Concentration [2]						
Inorganics (mg/Kg)							
Chloride	0	0	2 / 2	49	56	52.5	52.5
Nitrogen, Ammonia	0	0	5 / 5	27	168	99	99
Sulfate as SO4	0	0	5 / 5	83	19400	4048.6	4048.6

Notes:

1 Selection of OHM of Concern for this medium is presented in Table 1.

2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.

3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.

EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 22
SURFACE SOIL EXPOSURE POINT CONCENTRATIONS - SULFATE LANDFILL

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]
VOCs (mg/Kg)							
Toluene	0 : 0		1 / 1	0.003	0.003	0.003	0.003
SVOCs (mg/Kg)							
Benzo(a)Anthracene	0 : 0		1 / 1	0.038	0.038	0.038	0.038
Benzo(a)Pyrene	0 : 0		1 / 1	0.046	0.046	0.046	0.046
Benzo(b)Fluoranthene	0 : 0		1 / 1	0.0665	0.0665	0.0665	0.0665
Benzo(g,h,i)Perylene	0 : 0		1 / 1	0.029	0.029	0.2645	0.029
Benzo(k)Fluoranthene	0 : 0		1 / 1	0.018	0.018	0.259	0.018
Chrysene	0 : 0		1 / 1	0.0445	0.0445	0.0445	0.0445
Di-n-butylphthalate	0 : 0		1 / 1	0.017	0.017	0.181	0.017
Fluoranthene	0 : 0		1 / 1	0.0825	0.0825	0.0825	0.0825
Indeno (1,2,3-cd)Pyrene	0 : 0		1 / 1	0.047	0.047	0.047	0.047
Phenanthrene	0 : 0		1 / 1	0.042	0.042	0.042	0.042
Pyrene	0 : 0		1 / 1	0.063	0.063	0.063	0.063
bis(2-EthylHexyl)phthalate	0 : 0		1 / 1	0.083	0.083	0.083	0.083
Metals (mg/Kg)							
Aluminum	0 : 0		1 / 1	9750	9750	4826.667	4826.67
Arsenic	0 : 0		1 / 1	12	12	8.0333	8.0333
Barium	0 : 0		1 / 1	28	28	13.9167	13.9167
Calcium	0 : 0		1 / 1	1350	1350	627.1833	627.183
Chromium	0 : 0		1 / 1	17.5	17.5	63.6286	17.5
Cobalt	0 : 0		1 / 1	3.7	3.7	2.5417	2.5417
Iron	0 : 0		1 / 1	10000	10000	6990	6990
Lead	0 : 0		1 / 1	28.5	28.5	52.7667	28.5
Manganese	0 : 0		1 / 1	140	140	109.15	109.15
Nickel	0 : 0		1 / 1	10	10	4.1	4.1
Selenium	0 : 0		1 / 1	0.66	0.66	0.5175	0.5175
Sodium	0 : 0		1 / 1	37	37	62.1	37
Thallium	0 : 0		1 / 1	0.66	0.66	0.885	0.66

TABLE 22
SURFACE SOIL EXPOSURE POINT CONCENTRATIONS - SULFATE LANDFILL

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
Vanadium	0	0	1 / 1	17.5	17.5	14.8333	14.8333
Zinc	0	0	1 / 1	38	38	22.5167	22.5167
Inorganics (mg/Kg)							
Chloride	0	0	1 / 1	61.5	61.5	61.5	61.5
Nitrogen, Ammonia	0	0	1 / 1	17	17	17	17
Sulfate as SO4	0	0	1 / 1	30.5	30.5	30.5	30.5

Notes:

1 Selection of OHM of Concern for this medium is presented in Table 1.

2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.

3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.

EPC = Exposure Point Concentration

OHM = Oil or Hazardous Material

SQL = Sample Quantitation Limit

MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 23
SURFACE SOIL EXPOSURE POINT CONCENTRATIONS - SWMU 27 HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
VOCs (mg/Kg)							
Acetone	0 :	0	1 / 1	0.093	0.093	0.093	0.093
Methylene Chloride	0 :	0	1 / 1	0.047	0.047	0.047	0.047
Tetrachloroethene (PCE)	0 :	0	1 / 1	0.073	0.073	0.073	0.073
Toluene	0 :	0	1 / 1	0.015	0.015	0.015	0.015
SVOCs (mg/Kg)							
Anthracene	0.52 :	2.5	1 / 3	0.002	0.002	0.504	0.002
Benzo(a)Anthracene	0.52 :	2.5	1 / 3	0.008	0.008	0.506	0.008
Benzo(b)Fluoranthene	0.52 :	2.5	1 / 3	0.01	0.01	0.5067	0.01
Benzo(k)Fluoranthene	0.52 :	2.5	1 / 3	0.006	0.006	0.5053	0.006
Benzoic Acid	12 :	12	2 / 3	0.039	0.1	2.0463	0.1
Butylbenzylphthalate	0.4 :	0.52	1 / 3	2.6	2.6	1.02	1.02
Chrysene	0.52 :	2.5	1 / 3	0.012	0.012	0.5073	0.012
Di-n-butylphthalate	0 :	0	3 / 3	0.02	10	3.3567	3.3567
Di-n-octylphthalate	0.4 :	0.52	1 / 3	4.7	4.7	1.72	1.72
Diethylphthalate	2.5 :	2.5	2 / 3	0.01	0.033	0.431	0.033
Fluoranthene	2.5 :	2.5	2 / 3	0.008	0.015	0.4243	0.015
N-Nitrosodiphenylamine	0.52 :	0.52	2 / 3	0.075	32	10.7783	10.7783
Phenanthrene	0.52 :	2.5	1 / 3	0.011	0.011	0.507	0.011
Pyrene	2.5 :	2.5	2 / 3	0.011	0.015	0.4253	0.015
bis(2-EthylHexyl)phthalate	0 :	0	3 / 3	0.47	5500	1833.81	1833.81
Pesticides/PCBs (mg/Kg)							0
4,4'-DDE	0.04 :	0.04	2 / 3	0.002	0.0026	0.0082	0.0026
4,4'-DDT	0.04 :	0.04	2 / 3	0.0023	0.015	0.0124	0.0124
Alpha-BHC	0.002 :	0.0027	1 / 3	0.22	0.22	0.0741	0.0741
Alpha-Chlordane	0.0027 :	0.2	1 / 3	0.0002	0.0002	0.0339	0.0002
Dieldrin	0.004 :	0.04	1 / 3	0.0008	0.0008	0.0076	0.0008
Endosulfan II	0.004 :	0.0052	1 / 3	0.092	0.092	0.0322	0.0322

TABLE 23
SURFACE SOIL EXPOSURE POINT CONCENTRATIONS - SWMU 27 HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
Gamma-BHC (Lindane)	0.002 :	0.04	1 / 3	0.0001	0.0001	0.007	0.0001
Gamma-Chlordane	0.0027 :	0.02	1 / 3	0.0003	0.0003	0.0039	0.0003
Heptachlor Epoxide	0.002 :	0.02	1 / 3	0.0001	0.0001	0.0037	0.0001
Metals (mg/Kg)							
Aluminum	0 :	0	3 / 3	2030	8340	5190	5190
Antimony	1.1 :	1.1	2 / 3	1.2	76	25.9167	25.9167
Arsenic	1.6 :	1.6	2 / 3	4.3	7.5	4.2	4.2
Barium	0 :	0	3 / 3	11.5	21	14.8	14.8
Calcium	0 :	0	3 / 3	61.1	388	229.7	229.7
Chromium	0 :	0	3 / 3	3	4500	1661	1661
Cobalt	0 :	0	3 / 3	0.46	1.7	1.2867	1.2867
Iron	0 :	0	3 / 3	2310	6800	4870	4870
Lead	0 :	0	3 / 3	8.2	76.3	33.5	33.5
Manganese	0 :	0	3 / 3	1.7	43	21.5667	21.5667
Mercury	0.12 :	0.14	1 / 3	2.8	2.8	0.9767	0.9767
Nickel	0 :	0	3 / 3	4	6.1	5.3	5.3
Sodium	0 :	0	3 / 3	32	90.6	59.9	59.9
Vanadium	0 :	0	3 / 3	14	15.5	14.6667	14.6667
Zinc	0 :	0	3 / 3	14.9	42	25.2	25.2

TABLE 23
SURFACE SOIL EXPOSURE POINT CONCENTRATIONS - SWMU 27 HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
Inorganics (mg/Kg)							
Nitrogen, Ammonia	0	: 0	1 / 1	670	670	670	670
Sulfate as SO4	0	: 0	1 / 1	82	82	82	82

Notes:

1 Selection of OHM of Concern for this medium is presented in Table 1.

2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.

3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.

EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 24
SURFACE SOIL EXPOSURE POINT CONCENTRATIONS - SWMU 30 HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
VOCs (mg/Kg)							
Toluene	0 :	0	1 / 1	0.013	0.013	0.013	0.013
SVOCs (mg/Kg)							
Di-n-butylphthalate	0 :	0	1 / 1	0.4	0.4	0.4	0.4
N-Nitrosodiphenylamine	0 :	0	1 / 1	2.8	2.8	2.8	2.8
bis(2-EthylHexyl)phthalate	0 :	0	1 / 1	200	200	200	200
Pesticides/PCBs (mg/Kg)							
4,4'-DDT	0.065 :	0.065	1 / 2	1.7	1.7	0.8663	0.8663
Alpha-BHC	0.027 :	0.027	1 / 2	0.0058	0.0058	0.0097	0.0058
Endosulfan II	0.065 :	0.065	1 / 2	0.34	0.34	0.1863	0.1863
Metals (mg/Kg)							
Aluminum	0 :	0	2 / 2	3080	7300	5190	5190
Antimony	1.3 :	1.3	1 / 2	54	54	27.325	27.325
Arsenic	0 :	0	2 / 2	4.4	13	8.7	8.7
Barium	0 :	0	2 / 2	17.7	47	32.35	32.35
Calcium	0 :	0	2 / 2	258	650	454	454
Chromium	0 :	0	2 / 2	200	3600	1900	1900
Cobalt	0 :	0	2 / 2	1	4.4	2.7	2.7
Cyanide	0 :	0	1 / 1	7.5	7.5	7.5	7.5
Iron	0 :	0	2 / 2	3240	17000	10120	10120
Lead	0 :	0	2 / 2	24.2	38	31.1	31.1
Manganese	0 :	0	2 / 2	9.3	52	30.65	30.65
Mercury	0 :	0	2 / 2	0.15	3.2	1.675	1.675
Nickel	0 :	0	2 / 2	5.1	9.7	7.4	7.4
Selenium	0 :	0	2 / 2	0.51	1.5	1.005	1.005
Sodium	0 :	0	2 / 2	197	360	278.5	278.5
Vanadium	0 :	0	2 / 2	9.8	24	16.9	16.9
Zinc	0 :	0	2 / 2	8.3	32	20.15	20.15

TABLE 24
SURFACE SOIL EXPOSURE POINT CONCENTRATIONS - SWMU 30 HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
Inorganics (mg/Kg)							
Chloride	0	: 0	1 / 1	250	250	250	250
Nitrogen, Ammonia	0	: 0	1 / 1	400	400	400	400
Sulfate as SO4	0	: 0	1 / 1	1200	1200	1200	1200

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 1.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 25
SURFACE SOIL EXPOSURE POINT CONCENTRATIONS - SWMU 33 HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
VOCs (mg/Kg)							
Tetrachloroethene (PCE)	0 :	0	1 / 1	0.001	0.001	0.001	0.001
Toluene	0 :	0	1 / 1	0.001	0.001	0.001	0.001
SVOCs (mg/Kg)							
Anthracene	2.2 :	2.2	1 / 2	0.035	0.035	0.5675	0.035
Di-n-butylphthalate	0 :	0	2 / 2	0.074	0.27	0.172	0.172
Diethylphthalate	2.2 :	2.2	1 / 2	0.085	0.085	0.5925	0.085
Fluoranthene	2.2 :	2.2	1 / 2	0.081	0.081	0.5905	0.081
N-Nitrosodiphenylamine	2.2 :	2.2	1 / 2	0.55	0.55	0.825	0.55
Phenanthrene	2.2 :	2.2	1 / 2	0.14	0.14	0.62	0.14
Pyrene	2.3 :	2.3	1 / 2	0.085	0.085	0.6175	0.085
bis(2-EthylHexyl)phthalate	0 :	0	2 / 2	20	34	27	27
Pesticides/PCBs (mg/Kg)							
4,4'-DDE	0.1 :	0.1	1 / 2	0.0037	0.0037	0.0269	0.0037
4,4'-DDT	0.1 :	0.1	1 / 2	0.0016	0.0016	0.0258	0.0016
Aldrin	0.052 :	0.052	1 / 2	0.0001	0.0001	0.0131	0.0001
Dieldrin	0.1 :	0.1	1 / 2	0.0006	0.0006	0.0253	0.0006
PCB-1016	0 :	0	1 / 1	0.98	0.98	0.98	0.98
Metals (mg/Kg)							
Aluminum	0 :	0	2 / 2	9290	59000	34145	34145
Antimony	1 :	1	1 / 2	79	79	39.75	39.75
Arsenic	0 :	0	2 / 2	4.7	18	11.35	11.35
Barium	0 :	0	2 / 2	5.4	21	13.2	13.2
Beryllium	0.25 :	0.25	1 / 2	4	4	2.0625	2.0625
Cadmium	0.25 :	0.25	1 / 2	5.8	5.8	2.9625	2.9625
Calcium	0 :	0	2 / 2	77.4	1400	738.7	738.7
Chromium	0 :	0	2 / 2	6.1	5000	2503.05	2503.05
Cobalt	0 :	0	2 / 2	0.8	45	22.9	22.9

TABLE 25
SURFACE SOIL EXPOSURE POINT CONCENTRATIONS - SWMU 33 HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Minimum SQL : Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]
	Site Data/Concentration [2]					
Cyanide	0 : 0	1 / 1	5.2	5.2	5.2	5.2
Iron	0 : 0	2 / 2	6420	100000	53210	53210
Lead	0 : 0	2 / 2	7.5	62	34.75	34.75
Manganese	0 : 0	2 / 2	9.4	140	74.7	74.7
Mercury	0.1 : 0.1	1 / 2	0.4	0.4	0.225	0.225
Nickel	0 : 0	2 / 2	2.5	67	34.75	34.75
Sodium	0 : 0	2 / 2	49.9	680	364.95	364.95
Vanadium	0 : 0	2 / 2	11	37	24	24
Zinc	0 : 0	2 / 2	5.6	180	92.8	92.8
Inorganics (mg/Kg)						
Chloride	0 : 0	1 / 1	560	560	560	560
Nitrogen, Ammonia	0 : 0	1 / 1	300	300	300	300
Sulfate as SO4	0 : 0	1 / 1	2400	2400	2400	2400

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 1.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 26

SURFACE SOIL EXPOSURE POINT CONCENTRATIONS - AREA WITH BUILDINGS (EXCLUDING HOT SPOTS)

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
VOCs (mg/Kg)							
Tetrachloroethene (PCE)	0.005 :	0.0055	1 / 7	0.001	0.001	0.0024	0.001
Toluene	0.005 :	0.007	2 / 7	0.002	0.003	0.0027	0.0027
SVOCs (mg/Kg)							
2-Methylnaphthalene	0.33 :	0.99	2 / 7	0.067	0.075	0.2767	0.075
Acenaphthylene	0.33 :	0.92	2 / 7	0.033	0.057	0.2529	0.057
Anthracene	0.33 :	0.92	2 / 7	0.044	0.069	0.2561	0.069
Benzo(a)Anthracene	0.33 :	0.33	6 / 7	0.029	0.36	0.1434	0.1434
Benzo(a)Pyrene	0 :	0	7 / 7	0.03	0.24	0.1074	0.1074
Benzo(b)Fluoranthene	0 :	0	7 / 7	0.039	0.56	0.1894	0.1894
Benzo(g,h,i)Perylene	0.33 :	0.92	2 / 7	0.041	0.12	0.2651	0.12
Benzo(k)Fluoranthene	0.33 :	0.69	5 / 7	0.024	0.15	0.125	0.125
Butylbenzylphthalate	0.33 :	0.92	3 / 7	0.035	0.13	0.2251	0.13
Chrysene	0 :	0	7 / 7	0.053	0.64	0.2213	0.2213
Di-n-butylphthalate	0.33 :	0.92	5 / 7	0.014	0.036	0.1089	0.036
Di-n-octylphthalate	0.33 :	0.99	2 / 7	0.02	0.053	0.274	0.053
Dibenzo(a,h)Anthracene	0.33 :	0.99	1 / 7	0.074	0.074	0.3213	0.074
Diethylphthalate	0.33 :	0.99	1 / 7	0.033	0.033	0.3176	0.033
Fluoranthene	0 :	0	7 / 7	0.072	0.94	0.3024	0.3024
Indeno (1,2,3-cd)Pyrene	0.33 :	0.33	6 / 7	0.035	0.2	0.1016	0.1016
N-Nitrosodiphenylamine	0.33 :	0.92	2 / 7	0.059	0.48	0.3191	0.3191
Naphthalene	0.33 :	0.99	2 / 7	0.049	0.066	0.2729	0.066
Phenanthrene	0 :	0	7 / 7	0.031	0.68	0.2106	0.2106
Phenol	0.33 :	0.92	2 / 7	0.047	0.069	0.2587	0.069
Pyrene	0 :	0	7 / 7	0.056	0.66	0.2327	0.2327
bis(2-EthylHexyl)phthalate	0 :	0	7 / 7	0.13	2.2	1.06	1.06

TABLE 26

SURFACE SOIL EXPOSURE POINT CONCENTRATIONS - AREA WITH BUILDINGS (EXCLUDING HOT SPOTS)

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
Pesticides/PCBs (mg/Kg)							
4,4'-DDD	0.021 :	0.048	1 / 6	0.039	0.039	0.0218	0.0218
4,4'-DDE	0.021 :	0.048	1 / 6	0.049	0.049	0.0234	0.0234
4,4'-DDT	0.021 :	0.045	2 / 6	0.061	0.68	0.1348	0.1348
Metals (mg/Kg)							
Aluminum	0 :	0	7 / 7	4300	9000	5642.857	5642.86
Arsenic	0 :	0	7 / 7	6.8	19	10.7571	10.7571
Barium	0 :	0	7 / 7	14	42	26.8571	26.8571
Cadmium	1 :	1	1 / 7	1.3	1.3	0.6143	0.6143
Calcium	0 :	0	7 / 7	670	5200	1668.571	1668.57
Chromium	0 :	0	7 / 7	8.8	85	28.2571	28.2571
Cobalt	1.5 :	1.5	6 / 7	1.8	6.9	2.9929	2.9929
Iron	0 :	0	7 / 7	6600	16000	8528.571	8528.57
Lead	10 :	10	6 / 7	17	100	49.2857	49.2857
Manganese	0 :	0	7 / 7	40	210	90.5714	90.5714
Mercury	0.1 :	0.1	3 / 7	0.01	0.15	0.0714	0.0714
Nickel	0 :	0	7 / 7	4.7	18	9.7571	9.7571
Selenium	0.5 :	1.8	2 / 7	0.93	1.6	0.645	0.645
Sodium	0 :	0	7 / 7	33	80	49.2857	49.2857
Thallium	0.5 :	0.93	1 / 7	0.63	0.63	0.3721	0.3721
Vanadium	0 :	0	7 / 7	16	24	20	20
Zinc	0 :	0	7 / 7	21	150	56.7143	56.7143

TABLE 26

SURFACE SOIL EXPOSURE POINT CONCENTRATIONS - AREA WITH BUILDINGS (EXCLUDING HOT SPOTS)

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
Inorganics (mg/Kg)							
Chloride	40 :	40	1 / 7	68	68	26.8571	26.8571
Nitrogen, Ammonia	0 :	0	6 / 7	14	39	19.7143	19.7143
Sulfate as SO4	40 :	40	6 / 7	4.2	50	17.6857	17.6857

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 1.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 27
SUMMARY SURFACE SOIL EXPOSURE POINT CONCENTRATIONS - CURRENT AND FUTURE LAND USE[1]

Olin Corporation
Wilmington, MA Facility

	EPCs for Exposure Points 3								Area-Weighted EPCs for Exposure Points[4]								EPC	EPC	EPC	EPC
	Area with buildings				Area without buildings				Area with buildings				Area without buildings				Area with Buildings 6	Area without Buildings 6	Total Site 7	Total Site (Alternate)8
OHM of Concern 2	EP 9	EP 6	EP 3	EP 2	EP 4	EP 1	EP 7	EP 8	EP 9	EP 6	EP 3	EP 2	EP 4	EP 1	EP 7	EP 8				
					Fraction of Site Area 5 :				0.95	0.028	0.0094	0.013	0.6	0.325	0.042	0.042	0.62	0.38		
VOCs (mg/Kg)																				
1,1,1-Trichloroethane	0	0	0.0066	0.007	0.024	0.0067	0	0	0	0	6.2E-05	8.8E-05	0.0142	0.00218	0	0	0.00015044	0.0163975	0.0063	0.0057
1,1-Dichloroethene	0	0	0	0	0.004	0	0	0	0	0	0	0	0.0026	0	0	0	0	0.00258	0.00098	0.00098
2,4,4-Trimethyl-1-pentene	0	0	0	0	0	0.0043	0	0	0	0	0	0	0	0.0014	0	0	0	0.0013975	0.00053	0.00013
2-Butanone (MEK)	0	0	0.004	0	0	0.004	0	0	0	0	3.76E-05	0	0	0.0013	0	0	0.0000376	0.0013	0.00052	0.00015
Acetone	0	0.093	0.0212	0.012	0.016	0.0208	0	0	0	0.0026	0.000199	0.00016	0.0092	0.00676	0	0	0.00295928	0.01594	0.0079	0.0060
Methylene Chloride	0	0.047	0.002	0	0.005	0.0054	0	0	0	0.00132	1.88E-05	0	0.0031	0.00176	0	0	0.0013348	0.004875	0.0027	0.0022
Tetrachloroethene (PCE)	0.001	0.073	0	0	0	0	0	0.001	0.00095	0.00204	0	0	0	0	0	4.2E-05	0.002994	0.000042	0.0019	0.0019
Toluene	0.0027	0.015	0.001	9E-04	0.003	0.0033	0.013	0.001	0.00257	0.00042	9.4E-06	1.2E-05	0.002	0.00107	0.00055	4.2E-05	0.0030061	0.0037005	0.0033	0.0030
SVOCs (mg/Kg)																				
2-Methylnaphthalene	0.075	0	0	0	0	27.045	0	0	0.07125	0	0	0	0	8.78972	0	0	0.07125	8.7897225	3.4	0.9
2-Methylphenol (o-Cresol)	0	0	0	0	0	0.049	0	0	0	0	0	0	0	0.01593	0	0	0	0.015925	0.0061	0.0015
Acenaphthene	0	0	0	0	0	8.4841	0	0	0	0	0	0	0	2.75733	0	0	0	2.7573325	1.0	0.3
Acenaphthylene	0.057	0	0.027	0	0.045	20.367	0	0	0.05415	0	0.000254	0	0.027	6.61918	0	0	0.0544038	6.6461775	2.6	0.7
Anthracene	0.069	0.002	0.022	0	0.005	14.115	0	0.035	0.06555	5.6E-05	0.000207	0	0.003	4.58747	0	0.00147	0.0658128	4.5919425	1.8	0.5
Benzo(a)Anthracene	0.1434	0.008	0.07	0	0.099	7.0161	0	0	0.13623	0.00022	0.000658	0	0.0594	2.28023	0	0	0.137112	2.3396325	0.97	0.32
Benzo(a)Pyrene	0.1074	0	0	0	0.059	5.1281	0	0	0.10203	0	0	0	0.0354	1.66663	0	0	0.10203	1.7020325	0.71	0.24
Benzo(b)Fluoranthene	0.1894	0.01	0.107	0	0.18	2.4527	0	0	0.17993	0.00028	0.001006	0	0.108	0.79713	0	0	0.1812158	0.9051275	0.46	0.23
Benzo(g,h,i)Perylene	0.12	0	0	0	0	1.7607	0	0	0.114	0	0	0	0	0.57223	0	0	0.114	0.5722275	0.29	0.13
Benzo(k)Fluoranthene	0.125	0.006	0.0925	0	0.065	3.4991	0	0	0.11875	0.00017	0.00087	0	0.039	1.13721	0	0	0.1197875	1.1762075	0.52	0.20
Benzoic Acid	0	0.1	0.096	0	0.79	1.8	0	0	0	0.0028	0.000902	0	0.474	0.585	0	0	0.0037024	1.059	0.40	0.24
Butylbenzylphthalate	0.13	1.02	0.029	0	0	0.8	0	0	0.1235	0.02856	0.000273	0	0	0.26	0	0	0.1523326	0.26	0.19	0.12
Chrysene	0.2213	0.012	0.088	0	0.17	7.4942	0	0	0.21024	0.00034	0.000827	0	0.102	2.43562	0	0	0.2113982	2.537615	1.1	0.4
Di-n-butylphthalate	0.036	3.3567	0.3512	0.165	0.065	1.4	0.4	0.172	0.0342	0.09399	0.003301	0.00215	0.039	0.455	0.0168	0.00722	0.13363388	0.518024	0.28	0.15
Di-n-octylphthalate	0.053	1.72	0.022	0	0	0.17	0	0	0.05035	0.04816	0.000207	0	0	0.05525	0	0	0.0987166	0.05525	0.082	0.066
Dibenzofuran	0	0	0.016	0	0	2.246	0	0	0	0	0.00015	0	0	0.72995	0	0	0.0001504	0.72995	0.28	0.07
Diethylphthalate	0.033	0.033	0.0245	0	0.044	0.053	0	0.085	0.03135	0.00092	0.00023	0	0.0264	0.01723	0	0.00357	0.0325043	0.047195	0.038	0.033
Fluoranthene	0.3024	0.015	0.163	0.045	0.212	19.82	0	0.081	0.28728	0.00042	0.001532	0.00059	0.1272	6.44157	0	0.0034	0.2898172	6.572167	2.7	0.8
Fluorene	0	0	0.02	0	0	20.855	0	0	0	0	0.000188	0	0	6.77784	0	0	0.000188	6.7778425	2.6	0.6
Indeno (1,2,3-cd)Pyrene	0.1016	0	0	0	0.064	1.4995	0	0	0.09652	0	0	0	0.0384	0.48734	0	0	0.09652	0.5257375	0.26	0.12
N-Nitrosodiphenylamine	0.3191	10.7783	70.1037	2.75	0.3	1	2.8	0.55	0.30316	0.30179	0.658975	0.03575	0.18	0.325	0.1176	0.0231	1.29966218	0.6457	1.1	0.96
Naphthalene	0.066	0	0.013	0	0	26.866	0	0	0.0627	0	0.000122	0	0	8.73132	0	0	0.0628222	8.73132	3.4	0.9
Phenanthrene	0.2106	0.011	0.128	0	0.16	50.191	0	0.14	0.20007	0.00031	0.001203	0	0.096	16.3121	0	0.00588	0.2015812	16.413955	6.4	1.7
Phenol	0.069	0	0	0	0	2.4	0	0	0.06555	0	0	0	0	0.78	0	0	0.06555	0.78	0.34	0.11
Pyrene	0.2327	0.015	0.161	0	0.16	16.179	0	0.085	0.22107	0.00042	0.001513	0	0.096	5.25827	0	0.00357	0.2229984	5.3578425	2.2	0.7
bis(2-EthylHexyl)phthalate	1.06	1833.81	1.873	3.3	1.515	10.23	200	27	1.007	51.3467	0.017606	0.0429	0.909	3.32462	8.4	1.134	52.4141862	13.76762	37.7	36.8
Pesticides/PCBs (mg/Kg)																				
4,4'-DDD	0.0218	0	0.0007	0.003	5E-04	0.0043	0	0	0.02071	0	6.58E-06	3.4E-05	0.0003	0.0014	0	0	0.02075038	0.0016975	0.014	0.013
4,4'-DDE	0.0234	0.0026	0.001	0.002	0.003	0.0037	0	0.004	0.02223	7.3E-05	9.4E-06	2.5E-05	0.0016	0.0012	0	0.00016	0.0223369	0.0029179	0.015	0.015
4,4'-DDT	0.1348	0.0124	0.0067	0.005	0.01	0.0082	0.8663	0.002	0.12806	0.00035	6.3E-05	6.2E-05	0.0062	0.00267	0.03638	6.7E-05	0.12853258	0.0453568	0.097	0.096
Aldrin	0	0	0	9E-04	0.003	0.001	0	1E-04	0	0	0	1.2E-05	0.0018	0.00033	0	4.2E-06	0.0000117	0.0021292	0.00082	0.00072
Alpha-BHC	0	0.0741	0	0.003	0	0.0011	0.0058	0	0	0.00207	0	4.3E-05	0	0.00036	0.00024	0	0.0021177	0.0006011	0.0015	0.0014

TABLE 27

SUMMARY SURFACE SOIL EXPOSURE POINT CONCENTRATIONS - CURRENT AND FUTURE LAND USE[1]

Olin Corporation
Wilmington, MA Facility

OHM of Concern [2]	EPCs for Exposure Points [3]								Area-Weighted EPCs for Exposure Points[4]								EPC	EPC	EPC	EPC
	Area with buildings				Area without buildings				Area with buildings				Area without buildings				Area with Buildings [6]	Area without Buildings [6]	Total Site [7]	Total Site (Alternate)[8]
	EP 9	EP 6	EP 3	EP 2	EP 4	EP 1	EP 7	EP 8	EP 9	EP 6	EP 3	EP 2	EP 4	EP 1	EP 7	EP 8				
					Fraction of Site Area [5] :				0.95	0.028	0.0094	0.013	0.6	0.325	0.042	0.042	0.62	0.38		
Alpha-Chlordane	0	0.0002	0.0026	0.004	3E-04	0.009	0	0	0	5.6E-06	2.44E-05	5.3E-05	0.0002	0.00293	0	0	0.00008334	0.003105	0.0012	0.0004
Dieldrin	0	0.0008	0	0.004	0.001	0.004	0	6E-04	0	2.2E-05	0	5.7E-05	0.0006	0.0013	0	2.5E-05	0.0000796	0.0019252	0.00078	0.00041
Endosulfan I	0	0	0	0.005	0.002	0.0064	0	0	0	0	0	6.8E-05	0.0013	0.00208	0	0	0.0000676	0.00334	0.0013	0.0007
Endosulfan II	0	0.0322	0	0	0	0	0.1863	0	0	0.0009	0	0	0	0	0.00782	0	0.0009016	0.0078246	0.0035	0.0035
Endrin	0	0	0.0004	0	0.007	0	0	0	0	0	3.76E-06	0	0.0043	0	0	0	0.00000376	0.00432	0.0016	0.0016
Endrin Ketone	0	0	0	0.003	0.001	0.0031	0	0	0	0	0	4.4E-05	0.0008	0.00101	0	0	0.0000442	0.0018475	0.00073	0.00044
Gamma-BHC (Lindane)	0	0.0001	0.0004	0.004	0.025	0.0131	0	0	0	2.8E-06	3.76E-06	5.3E-05	0.0147	0.00426	0	0	0.00005986	0.0189575	0.0072	0.0060
Gamma-Chlordane	0	0.0003	0.0012	0.005	0.005	0.0003	0	0	0	8.4E-06	1.13E-05	6.4E-05	0.0031	9.8E-05	0	0	0.00008338	0.0032175	0.0013	0.0012
Heptachlor	0	0	0	9E-04	0	0.0004	0	0	0	0	0	1.2E-05	0	0.00013	0	0	0.0000117	0.00013	0.000057	0.000020
Heptachlor Epoxide	0	0.0001	0	0.002	4E-04	0.0001	0	0	0	2.8E-06	0	2.5E-05	0.0002	3.3E-05	0	0	0.0000275	0.0002725	0.00012	0.00011
PCB-1016	0	0	0	0	0	0	0	0.98	0	0	0	0	0	0	0	0.04116	0	0.04116	0.016	0.0156408
Metals (mg/Kg)																				
Aluminum	5642.86	5190	4055	9230	4827	3671.3	5190	34145	5360.71	145.32	38.117	119.99	2896	1193.16	217.98	1434.09	5664.141245	5741.22627	5,693	5,353
Antimony	0	25.9167	1.025	1.2	0	1.3	27.325	39.75	0	0.72567	0.009635	0.0156	0	0.4225	1.14765	1.6695	0.7509026	3.23965	1.70	1.58
Arsenic	10.7571	4.2	4.0667	20.3	8.033	6.5313	8.7	11.35	10.2192	0.1176	0.038227	0.2639	4.82	2.12267	0.3654	0.4767	10.63897198	7.7847525	9.55	8.95
Barium	26.8571	14.8	10.5667	32.75	13.92	10.85	32.35	13.2	25.5142	0.4144	0.099327	0.42575	8.35	3.52625	1.3587	0.5544	26.45372198	13.78937	21.6	20.6
Beryllium	0	0	0.2092	0.465	0	0	0	2.063	0	0	0.001966	0.00605	0	0	0	0.08663	0.00801148	0.086625	0.038	0.038
Cadmium	0.6143	0	0	0	0	0	0	2.963	0.58359	0	0	0	0	0	0	0.12443	0.583585	0.124425	0.41	0.41
Calcium	1668.57	229.7	444.167	1955	627.2	9826.8	454	738.7	1585.14	6.4316	4.175167	25.415	376.31	3193.69	19.068	31.0254	1621.164597	3620.09713	2,381	1,471
Chromium	28.2571	1661	90.3167	32.15	63.63	254.79	1900	2503	26.8442	46.508	0.848977	0.41795	38.177	82.8069	79.8	105.128	74.61917198	305.9121725	163	139
Cobalt	2.9929	1.2867	1.9833	7.6	2.542	1.4094	2.7	22.9	2.84326	0.03603	0.018643	0.0988	1.525	0.45806	0.1134	0.9618	2.99672562	3.058275	3.02	2.89
Cyanide	0	0	0	0	0	0	7.5	5.2	0	0	0	0	0	0	0.315	0.2184	0	0.5334	0.20	0.20
Iron	8528.57	4870	5253.33	12390	6990	5596.3	10120	53210	8102.14	136.36	49.38133	161.07	4194	1818.78	425.04	2234.82	8448.954163	8672.64125	8,534	8,016
Lead	49.2857	33.5	37.8167	13.2	52.77	15.2	31.1	34.75	46.8214	0.938	0.355477	0.1716	31.66	4.94	1.3062	1.4595	48.28649198	39.36572	44.9	43.5
Manganese	90.5714	21.5667	52.5667	230	109.2	33.788	30.65	74.7	86.0428	0.60387	0.494127	2.99	65.49	10.9809	1.2873	3.1374	90.13082458	80.8956375	86.6	83.5
Mercury	0.0714	0.9767	0.105	0.078	0.084	0.1495	1.675	0.225	0.06783	0.02735	0.000987	0.00101	0.0505	0.04859	0.07035	0.00945	0.0971721	0.1789075	0.13	0.11
Nickel ·	9.7571	5.3	5.6	20.15	4.1	3.295	7.4	34.75	9.26925	0.1484	0.05264	0.26195	2.46	1.07088	0.3108	1.4595	9.732235	5.301175	8.05	7.74
Selenium	0.645	0	0.9517	0.98	0.518	0.8581	1.005	0	0.61275	0	0.008946	0.01274	0.3108	0.27888	0.04221	0	0.63443598	0.6315925	0.63	0.56
Sodium	48.2857	59.9	99.4667	152.5	62.1	86.925	278.5	365	46.8214	1.6772	0.934967	1.9825	37.26	28.2506	11.697	15.3279	51.41610198	92.535525	67.0	59.0
Thallium	0.3721	0	1.4167	1.8	0.885	0.8288	0	0	0.3535	0	0.013317	0.0234	0.531	0.26936	0	0	0.39021198	0.80036	0.55	0.47
Vanadium	20	14.6667	8.1333	18.1	14.83	10.325	16.9	24	19	0.41067	0.076453	0.2353	8.9	3.35563	0.7098	1.008	19.72242062	13.973405	17.5	16.6
Zinc	56.7143	25.2	35.2667	50.1	22.52	16.15	20.15	92.8	53.8786	0.7056	0.331507	0.6513	13.51	5.24875	0.8463	3.8976	55.56699198	23.50267	43.4	41.9
Inorganics (mg/Kg)																				
Chloride	26.8571	0	0	0	52.5	110	250	560	25.5142	0	0	0	31.5	35.75	10.5	23.52	25.514245	101.27	54.3	44.1
Nitrogen, Ammonia	19.7143	670	44.2667	70.2	99	163.91	400	300	18.7286	18.76	0.416107	0.9126	59.4	53.2701	16.8	12.6	38.81729198	142.0700675	78.1	62.9
Sulfate as SO4	17.6857	82	0	1285	4049	7253.2	1200	2400	16.8014	2.296	0	16.705	2429.2	2357.28	50.4	100.8	35.602415	4937.636318	1,898	1,227

Notes:

1 The total site EPC is used to evaluate current risks to all receptors and future risks to all receptors except the full-time, long-term industrial worker (see footnote 8).
2 Selection of OHM of Concern for this medium is presented in Table 1.
3 EPCs for each exposure point in this medium are presented in the surface soil exposure point concentration tables.
4 EPCs calculated by multiplying the EPC for the exposure point by the fractional site area of that exposure point.
5 Fractional site area represents the area of the exposure point divided by the area of the portion of the site containing those exposure points (see surface soil exposure point figure).
For area with buildings, the area of each exposure point in the portion of the site containing buildings was divided by the total area of the portion of the site containing buildings.
For area without buildings, the area of each exposure point in the portion of the site not containing buildings was divided by the total area of the portion of the site not containing buildings (excluding sulfate landfill).

TABLE 27
SUMMARY SURFACE SOIL EXPOSURE POINT CONCENTRATIONS - CURRENT AND FUTURE LAND USE[1]

Olin Corporation
Wilmington, MA Facility

	EPCs for Exposure Points [3]								Area-Weighted EPCs for Exposure Points[4]								EPC	EPC	EPC	EPC
	Area with buildings				Area without buildings				Area with buildings				Area without buildings							
OHM of Concern [2]	EP 9	EP 6	EP 3	EP 2	EP 4	EP 1	EP 7	EP 8	EP 9	EP 6	EP 3	EP 2	EP 4	EP 1	EP 7	EP 8	Area with Buildings [6]	Area without Buildings [6]	Total Site [7]	.Total Site (Alternate)[8]
					Fraction of Site Area [5] :				0.95	0.028	0.0094	0.013	0.6	0.325	0.042	0.042	0.62	0.38		

The fractional areas for area with buildings and area without buildings were calculated by dividing the areas of those portions of the site by the area of the entire site (excluding sulfate landfill).
6 The final area-weighted EPC is the sum of the area-weighted EPCs for each exposure point in the areas with and without buildings, respectively.
7 EPC calculated by adding the EPCs for area without buildings and area with buildings, each multiplied by their respective fractional site areas.
8 EPC calculated as described in footnotes 4 through 7. However, the EPC for Area 8 (EP 1) was weighted by an additional factor of 0.25 to account for a lower likelihood that the full-time, long-term industrial worker would be exposed to this area under future conditions.
"0" indicates that OHM was not detected in samples collected at exposure point. "Blank" indicates that OHM was not analyzed for or data were rejected.
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

Area with Buildings:
EP9 - Area with buildings (excluding hot spots)
EP6 - SWMU 27 hot spot
EP3 - Lake Poly hot spot
EP2 - Drum Area A hot spot

Area without buildings:
EP4 - Area without buildings (excluding hot spots and sulfate landfill)
EP1 - Area 8 hot spot
EP7 - SWUM 30 hot spot
EP8 - SWMU 33 hot spot

TABLE 28
SUBSURFACE SOIL EXPOSURE POINT CONCENTRATIONS - LAKE POLY HOT SPOT

Olin Corporation
Wilmington, MA Facility

	Site Data/Concentration [2]						
OHM of Concern [1]	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]
VOCs (mg/Kg)							
1,2-Dichloroethane	0.0055 :	0.043	1 / 11	0.002	0.002	0.0046	0.002
2,4,4-Trimethyl-1-pentene	0.011 :	0.011	10 / 11	0.006	340	32.3303	32.3303
2,4,4-Trimethyl-2-Pentene	0.011 :	0.017	8 / 11	0.002	210	20.0941	20.0941
2-Butanone (MEK)	0.016 :	0.02	4 / 11	0.007	0.084	0.0196	0.0196
2-Hexanone	0.016 :	0.13	1 / 11	0.007	0.007	0.0137	0.007
Acetone	0.016 :	0.13	5 / 11	0.018	0.24	0.0605	0.0605
Benzene	0.0055 :	0.043	2 / 11	0.001	0.002	0.0044	0.002
Carbon Disulfide	0.011 :	0.085	2 / 11	0.005	0.013	0.0097	0.0097
Carbon Tetrachloride	0.0055 :	0.043	1 / 11	0.003	0.003	0.0046	0.003
Chlorobenzene	0.0055 :	0.006	2 / 11	0.053	0.53	0.0554	0.0554
Chloroform	0.0055 :	0.043	1 / 11	0.001	0.001	0.0045	0.001
Ethylbenzene	0.0055 :	0.006	4 / 11	0.015	0.61	0.0729	0.0729
Methylene Chloride	0.011 :	0.012	4 / 11	0.002	0.02	0.0064	0.0064
Styrene	0.0055 :	0.006	6 / 11	0.001	0.11	0.013	0.013
Tetrachloroethene (PCE)	0.0055 :	0.006	2 / 11	0.005	0.023	0.0049	0.0049
Toluene	0.0055 :	0.006	9 / 11	0.0006	1.1	0.1347	0.1347
Xylenes, Total	0.0055 :	0.006	4 / 11	0.003	0.22	0.0338	0.0338
SVOCs (mg/Kg)							
1,2,4-Trichlorobenzene	0.4 :	0.82	2 / 11	0.088	1.8	0.4539	0.4539
1,2-Dichlorobenzene	0.4 :	0.82	2 / 11	0.17	2.1	0.4886	0.4886
1,3-Dichlorobenzene	0.4 :	0.83	1 / 11	0.29	0.29	0.3464	0.29
1,4-Dichlorobenzene	0.4 :	0.82	2 / 11	0.23	2.6	0.5396	0.5396
2-Methylnaphthalene	0.4 :	0.83	1 / 11	0.063	0.063	0.318	0.063
4-Bromophenyl-phenylether	0.4 :	0.83	1 / 4	1.1	1.1	0.4825	0.4825
4-Chlorophenyl-phenylether	0.4 :	0.82	2 / 11	0.17	2.2	0.4977	0.4977
Benzo(a)Anthracene	0.4 :	0.83	2 / 11	0.048	0.052	0.2855	0.052
Benzo(b)Fluoranthene	0.4 :	0.83	3 / 11	0.039	0.049	0.2537	0.049

TABLE 28
SUBSURFACE SOIL EXPOSURE POINT CONCENTRATIONS - LAKE POLY HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
Butylbenzylphthalate	0.4	0.83	6 / 11	0.15	4.5	0.8868	0.8868
Chrysene	0.4	0.83	2 / 11	0.058	0.089	0.2897	0.089
Di-n-butylphthalate	0.43	1.3	4 / 11	0.032	32	4.427	4.427
Di-n-octylphthalate	0.4	0.79	7 / 11	0.059	0.38	0.1991	0.1991
Dibenzofuran	0.4	0.82	3 / 11	0.095	1.4	0.395	0.395
Fluoranthene	0.4	0.82	3 / 11	0.038	0.082	0.2547	0.082
Hexachlorobenzene	0.4	0.83	1 / 11	0.24	0.24	0.3418	0.24
N-Nitrosodiphenylamine	0.76	0.79	9 / 11	0.15	3400	374.4477	374.448
Naphthalene	0.4	0.82	3 / 11	0.092	0.72	0.3375	0.3375
Phenanthrene	0.4	0.82	5 / 11	0.052	0.69	0.3354	0.3354
Phenol	0.4	0.82	3 / 11	0.055	0.25	0.2882	0.25
Pyrene	0.4	0.82	6 / 11	0.057	0.2	0.2113	0.2
bis(2-EthylHexyl)phthalate	0	0	11 / 11	0.97	6700	903.0609	903.061
Pesticides/PCBs (mg/Kg)							
4,4'-DDD	0.035	0.04	1 / 7	0.04	0.04	0.0219	0.0219
Aldrin	0.018	0.02	1 / 7	0.032	0.032	0.0126	0.0126
Alpha-BHC	0.018	0.02	1 / 7	0.024	0.024	0.0115	0.0115
Endosulfan Sulfate	0.035	0.04	1 / 7	0.15	0.15	0.0376	0.0376
Endrin	0.035	0.04	1 / 7	0.089	0.089	0.0289	0.0289
Metals (mg/Kg)							
Antimony	0.5	20	1 / 11	41	41	9.2755	9.2755
Arsenic	2.9	2.9	10 / 11	2.3	7.1	4.0136	4.0136
Barium	0	0	11 / 11	8.4	65	22.2909	22.2909
Cadmium	1	1.1	1 / 11	1	1	0.55	0.55
Calcium	0	0	11 / 11	420	1400	794.5455	794.546
Chromium	0	0	11 / 11	68	17000	2316.091	2316.09
Cobalt	3	3	8 / 11	1.6	4.4	2.6364	2.6364
Copper	0	0	11 / 11	3.4	16	8.8182	8.8182

TABLE 28
SUBSURFACE SOIL EXPOSURE POINT CONCENTRATIONS - LAKE POLY HOT SPOT

Olin Corporation
Wilmington, MA Facility

	Site Data/Concentration [2]						
OHM of Concern [1]	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]
Cyanide	2 :	2	3 / 7	2.3	5.4	2	2
Iron	0 :	0	11 / 11	4900	9900	7054.546	7054.55
Manganese	0 :	0	11 / 11	34	100	62.7273	62.7273
Mercury	0.1 :	0.15	4 / 11	0.1	0.52	0.1277	0.1277
Nickel	4 :	4	8 / 11	4.7	9.9	5.8091	5.8091
Potassium	0 :	0	11 / 11	130	1300	639.0909	639.091
Sodium	0 :	0	11 / 11	23	200	101.1818	101.182
Vanadium	0 :	0	11 / 11	4.8	24	13.2818	13.2818
Inorganics (mg/Kg)							
Chloride	40 :	40	2 / 11	98	100	34.3636	34.3636
Nitrogen, Ammonia	0 :	0	11 / 11	10	10000	1028.455	1028.45
Sulfate as SO4	20 :	80	6 / 11	40	260	65.0909	65.0909

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 2.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
The median represents the median value of all sample results, including non-detects, with the SQL used as the value for non-detects.
3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 29
SUBSURFACE SOIL EXPOSURE POINT CONCENTRATIONS - DRUM AREA B HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
VOCs (mg/Kg)							
2-Butanone (MEK)	0.0027 :	2	1 / 3	0.0034	0.0034	0.3349	0.0034
4-Methyl-2-Pentanone (MIBK)	0.0027 :	0.0029	1 / 3	1.5	1.5	0.5009	0.5009
Acetone	0.0046 :	0.0046	2 / 3	0.25	690	230.0841	230.084
Benzene	0.0009 :	0.001	1 / 3	3.8	3.8	1.267	1.267
Chlorobenzene	0.0009 :	0.001	1 / 3	0.86	0.86	0.287	0.287
Ethylbenzene	0.0009 :	0.001	1 / 3	0.32	0.32	0.107	0.107
Methylene Chloride	0.0018 :	0.156	1 / 3	0.69	0.69	0.2563	0.2563
Toluene	0 :	0	3 / 3	0.0003	13	4.3336	4.3336
Xylenes, Total	0.0009 :	0.001	1 / 3	1.7	1.7	0.567	0.567
SVOCs (mg/Kg)							
1,2,3-Trichlorobenzene	0 :	0	1 / 1	1.4	1.4	1.4	1.4
1,2,4-Trichlorobenzene	0.99 :	0.99	1 / 2	0.35	0.35	0.4225	0.35
1,2-Dichlorobenzene	0.99 :	0.99	2 / 3	0.84	4.7	2.0117	2.0117
1,4-Dichlorobenzene	0.99 :	0.99	2 / 3	1.2	5.6	2.4317	2.4317
2,4-Dimethylphenol	0.99 :	0.99	2 / 3	0.88	3.5	1.625	1.625
2-Methylphenol (o-Cresol)	0.99 :	0.99	2 / 3	2.9	8	3.7983	3.7983
4-Methylphenol(p-Cresol)	0.99 :	0.99	2 / 3	3.6	8.8	4.2983	4.2983
Di-n-butylphthalate	1.3 :	1.3	2 / 3	0.12	0.23	0.3333	0.23
Di-n-octylphthalate	0.53 :	10	1 / 3	0.88	0.88	2.0483	0.88
Dibenzofuran	0.99 :	0.99	2 / 3	0.1	0.57	0.3883	0.3883
N-Nitrosodiphenylamine	0.99 :	10	1 / 3	1.5	1.5	2.3317	1.5
Naphthalene	0.99 :	0.99	2 / 3	4.1	5.7	3.4317	3.4317
Phenol	0.53 :	0.99	1 / 3	510	510	170.2533	170.253
bis(2-EthylHexyl)phthalate	0 :	0	3 / 3	0.95	1100	367.8167	367.817
Pesticides/PCBs (mg/Kg)							
Endosulfan I	0.026 :	0.03	1 / 3	0.036	0.036	0.0213	0.0213

TABLE 29
SUBSURFACE SOIL EXPOSURE POINT CONCENTRATIONS - DRUM AREA B HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL		Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]
Metals (mg/Kg)								
Arsenic	0.0044	:	0.0044	2 / 3	0.004	1.4	0.4687	0.4687
Barium	0	:	0	3 / 3	0.0014	6.2	2.0708	2.0708
Cadmium	0.001	:	0.001	2 / 3	0.0026	1.3	0.4344	0.4344
Calcium	0	:	0	3 / 3	5	1900	688.3333	688.333
Chromium	0	:	0	3 / 3	0.024	5.5	1.878	1.878
Copper	0	:	0	3 / 3	0.005	18	6.0037	6.0037
Iron	0	:	0	3 / 3	2.6	1900	647.5333	647.533
Manganese	0	:	0	3 / 3	0.049	18	6.053	6.053
Mercury	0.0002	:	0.1	1 / 3	0.0009	0.0009	0.017	0.0009
Nickel	0.004	:	0.004	1 / 3	25	25	8.3347	8.3347
Potassium	0	:	0	3 / 3	0.05	220	73.4433	73.4433
Sodium	0	:	0	3 / 3	0.11	8600	2867.103	2867.1
Vanadium	0	:	0	3 / 3	0.0099	35	11.674	11.674
Inorganics (mg/Kg)								
Chloride	0.04	:	0.04	1 / 2	0.22	0.22	0.12	0.12
Nitrogen, Ammonia	0	:	0	2 / 2	0.047	0.1	0.0735	0.0735
Sulfate as SO4	0	:	0	2 / 2	350	29000	14675	14675

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 2.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
The median represents the median value of all sample results, including non-detects, with the SQL used as the value for non-detects.
3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.
EPC = Exposure Point Concentration

TABLE 29
SUBSURFACE SOIL EXPOSURE POINT CONCENTRATIONS - DRUM AREA B HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	

OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 30
SUBSURFACE SOIL EXPOSURE POINT CONCENTRATIONS - DRUM AREA A HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
VOCs (mg/Kg)							
1,2-Dichloroethane	0.0007 :	0.7	1 / 7	0.082	0.082	0.1281	0.082
2,4,4-Trimethyl-1-pentene	0 :	0	3 / 3	0.68	360	120.52	120.52
2,4,4-Trimethyl-2-Pentene	0 :	0	3 / 3	0.19	93	31.2267	31.2267
2-Butanone (MEK)	0.002 :	2	2 / 7	0.04	0.099	0.3702	0.099
2-Hexanone	0.002 :	2	3 / 7	0.6	3	0.9039	0.9039
4-Methyl-2-Pentanone (MIBK)	0.002 :	2	2 / 7	0.1	3	0.7611	0.7611
Acetone	0.002 :	2	2 / 7	0.31	11	1.8075	1.8075
Benzene	0.0007 :	0.9	1 / 7	0.035	0.035	0.175	0.035
Carbon Disulfide	0.0013 :	1	2 / 7	0.5	3.4	0.6617	0.6617
Chlorobenzene	0.0007 :	0.9	1 / 7	0.041	0.041	0.1758	0.041
Ethylbenzene	0.0007 :	0.7	2 / 7	0.14	0.9	0.215	0.215
Methylene Chloride	0.0013 :	2	1 / 7	0.77	0.77	0.3515	0.3515
Toluene	0.0007 :	0.0011	5 / 7	0.052	1.4	0.579	0.579
Xylenes, Total	0.0007 :	0.15	3 / 7	0.093	1.1	0.3097	0.3097
SVOCs (mg/Kg)							
4-Methylphenol(p-Cresol)	0.33 :	12	1 / 7	0.038	0.038	1.924	0.038
Butylbenzylphthalate	0.33 :	12	1 / 7	1.1	1.1	2.0757	1.1
Di-n-butylphthalate	0.33 :	12	1 / 7	3.1	3.1	2.1757	2.1757
Di-n-octylphthalate	0.33 :	12	1 / 7	0.2	0.2	1.9471	0.2
Indeno (1,2,3-cd)Pyrene	0.33 :	12	1 / 7	31	31	5.6614	5.6614
Isophorone	0.33 :	12	2 / 7	0.9	2.1	1.6329	1.6329
N-Nitrosodiphenylamine	1.2 :	12	5 / 7	5.4	21000	4746.143	4746.14
Naphthalene	0.33 :	12	1 / 7	0.077	0.077	1.9296	0.077
Phenol	0.33 :	12	2 / 7	0.81	1	1.9629	1
bis(2-EthylHexyl)phthalate	0.33 :	0.33	5 / 7	4.4	87	24.2471	24.2471
Pesticides/PCBs (mg/Kg)							
Alpha-Chlordane	0.04 :	6.1	1 / 7	2	2	1.095	1.095
Methoxychlor	0.04 :	6.1	1 / 7	2	2	1.095	1.095

TABLE 30
SUBSURFACE SOIL EXPOSURE POINT CONCENTRATIONS - DRUM AREA A HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
Toxaphene	0.07 :	12	1 / 7	4	4	2.1821	2.1821
Metals (mg/Kg)							
Arsenic	0.0015 :	0.0034	5 / 7	0.0017	7.5	1.8583	1.8583
Barium	0.0005 :	0.0005	5 / 6	0.0036	49	10.2525	10.2525
Cadmium	0.001 :	1	3 / 7	0.004	5.1	0.9722	0.9722
Calcium	0 :	0	7 / 7	0.11	61000	10814.38	10814.4
Chromium	0 :	0	7 / 7	0.0066	59	21.1728	21.1728
Cobalt	0.0015 :	1.5	4 / 7	0.0016	8.7	1.7512	1.7512
Copper	0 :	0	7 / 7	0.0028	57	14.6183	14.6183
Iron	0 :	0	7 / 7	0.21	94000	16848.84	16848.8
Manganese	0 :	0	7 / 7	0.0034	460	94.3222	94.3222
Mercury	0.0001 :	0.15	2 / 7	0.0002	0.0002	0.0258	0.0002
Nickel	0 :	0	7 / 7	0.0046	30	9.1515	9.1515
Potassium	0 :	0	7 / 7	0.0035	680	224.0016	224.002
Sodium	0 :	0	7 / 7	0.023	530	119.7781	119.778
Vanadium	0.0025 :	0.0026	4 / 7	0.007	27	7.8444	7.8444
Inorganics (mg/Kg)							
Chloride	0 :	0	4 / 4	0.92	25	11.78	11.78
Nitrogen, Ammonia	0 :	0	4 / 4	0.02	2.1	0.5975	0.5975
Sulfate as SO4	0 :	0	2 / 2	600	5600	3100	3100

Notes:

1 Selection of OHM of Concern for this medium is presented in Table 2.

2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
The median represents the median value of all sample results, including non-detects, with the SQL used as the value for non-detects.

3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum

TABLE 30
SUBSURFACE SOIL EXPOSURE POINT CONCENTRATIONS - DRUM AREA A HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	

detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.

EPC = Exposure Point Concentration

OHM = Oil or Hazardous Material

SQL = Sample Quantitation Limit

MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 31
SUBSURFACE SOIL EXPOSURE POINT CONCENTRATIONS - FORMER LAGOON AREA HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
VOCs (mg/Kg)							
2,4,4-Trimethyl-1-pentene	0.011 :	0.011	4 / 9	0.002	3.3	0.3758	0.3758
2,4,4-Trimethyl-2-Pentene	0.011 :	0.011	5 / 9	0.001	0.91	0.1067	0.1067
2-Butanone (MEK)	0.016 :	0.082	4 / 10	0.001	0.49	0.0577	0.0577
2-Hexanone	0.016 :	2	1 / 10	0.061	0.061	0.1192	0.061
Acetone	0.016 :	0.019	5 / 10	0.041	17	1.8174	1.8174
Benzene	0.0055 :	0.028	1 / 10	0.1	0.1	0.0148	0.0148
Chloroform	0.0055 :	0.7	1 / 10	0.002	0.002	0.0397	0.002
Methylene Chloride	0.011 :	0.055	1 / 10	2	2	0.2094	0.2094
Tetrachloroethene (PCE)	0.0055 :	0.7	1 / 10	0.001	0.001	0.0396	0.001
Toluene	0.0055 :	0.028	4 / 10	0.001	0.15	0.0192	0.0192
Trichloroethene (TCE)	0.0055 :	0.028	1 / 10	0.08	0.08	0.0128	0.0128
SVOCs (mg/Kg)							
1,2,4-Trichlorobenzene	0.69 :	0.76	2 / 10	0.075	0.086	0.3091	0.086
Anthracene	0.73 :	0.79	1 / 10	0.028	0.028	0.3373	0.028
Benzo(a)Anthracene	0.73 :	0.79	1 / 10	0.08	0.08	0.3425	0.08
Benzo(a)Pyrene	0.73 :	0.79	1 / 10	0.055	0.055	0.34	0.055
Benzo(b)Fluoranthene	0.73 :	0.79	1 / 10	0.084	0.084	0.3429	0.084
Butylbenzylphthalate	0.69 :	0.76	1 / 10	0.035	0.035	0.333	0.035
Chrysene	0.73 :	0.79	1 / 10	0.086	0.086	0.3431	0.086
Di-n-octylphthalate	0.69 :	0.79	3 / 10	0.014	0.073	0.2727	0.073
Fluoranthene	0.73 :	0.79	1 / 10	0.16	0.16	0.3505	0.16
N-Nitrosodiphenylamine	0.69 :	0.76	5 / 10	0.15	0.98	0.397	0.397
Naphthalene	0.69 :	0.76	1 / 10	0.63	0.63	0.3925	0.3925
Phenanthrene	0.73 :	0.79	1 / 10	0.12	0.12	0.3465	0.12
Phenol	0.69 :	0.76	2 / 10	0.075	0.1	0.3105	0.1
Pyrene	0.73 :	0.79	1 / 10	0.13	0.13	0.3475	0.13
bis(2-EthylHexyl)phthalate	0.69 :	1.4	6 / 10	1.7	27	4.862	4.862

TABLE 31
SUBSURFACE SOIL EXPOSURE POINT CONCENTRATIONS - FORMER LAGOON AREA HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
Pesticides/PCBs (mg/Kg)							
Endrin Ketone	0.034 :	0.038	1 / 10	0.045	0.045	0.0204	0.0204
Gamma-BHC (Lindane)	0.017 :	0.019	1 / 10	0.048	0.048	0.0129	0.0129
Metals (mg/Kg)							
Arsenic	0 :	0	10 / 10	1.1	21	10.2	10.2
Barium	0 :	0	10 / 10	6.6	39	25.66	25.66
Cadmium	1 :	1	6 / 10	1.2	1.8	1.02	1.02
Calcium	0 :	0	10 / 10	1600	16000	5180	5180
Chromium	0 :	0	10 / 10	7.3	160	46.03	46.03
Cobalt	1.5 :	1.5	9 / 10	1.8	7.2	4.025	4.025
Copper	2.5 :	2.5	9 / 10	4	47	12.825	12.825
Iron	0 :	0	10 / 10	840	15000	9764	9764
Manganese	0 :	0	10 / 10	7.6	320	156.56	156.56
Nickel	4 :	4	9 / 10	4.8	18	10.94	10.94
Potassium	0 :	0	10 / 10	160	2100	1263	1263
Sodium	0 :	0	10 / 10	67	240	121.1	121.1
Vanadium	1.5 :	1.5	9 / 10	5.9	21	13.665	13.665
Inorganics (mg/Kg)							
Chloride	40 :	40	5 / 10	57	100	47.8	47.8
Nitrogen, Ammonia	0 :	0	10 / 10	8.4	210	68.34	68.34
Sulfate as SO4	0 :	0	10 / 10	210	33000	6199	6199

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 2.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
The median represents the median value of all sample results, including non-detects, with the SQL used as the

TABLE 31
SUBSURFACE SOIL EXPOSURE POINT CONCENTRATIONS - FORMER LAGOON AREA HOT SPOT

Olin Corporation
Wilmington, MA Facility

	Site Data/Concentration [2]						
	Minimum	Maximum	Frequency of			Arithmetic	
OHM of Concern [1]	SQL	SQL	Detection	Minimum	Maximum	Mean	EPC [3]

value for non-detects.

3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.

EPC = Exposure Point Concentration

OHM = Oil or Hazardous Material

SQL = Sample Quantitation Limit

MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 32
SUBSURFACE SOIL EXPOSURE POINT CONCENTRATIONS - PLANT B AREA HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]
VOCs (mg/Kg)							
1,2-Dichloroethane	0.0055 :	0.0055	1 / 4	0.035	0.035	0.0108	0.0108
2,4,4-Trimethyl-1-pentene	0 :	0	5 / 5	0.028	1.7	0.7236	0.7236
2,4,4-Trimethyl-2-Pentene	0 :	0	5 / 5	0.015	0.72	0.2576	0.2576
2-Butanone (MEK)	0.016 :	0.016	2 / 4	0.006	0.017	0.0098	0.0098
2-Hexanone	0.016 :	0.016	3 / 5	0.026	0.078	0.0378	0.0378
4-Methyl-2-Pentanone (MIBK)	0.016 :	0.016	1 / 4	0.027	0.027	0.0128	0.0128
Acetone	0.016 :	0.017	1 / 4	0.09	0.09	0.0286	0.0286
Carbon Tetrachloride	0.0055 :	0.0055	1 / 4	0.009	0.009	0.0043	0.0043
Chlorobenzene	0.0055 :	0.0055	1 / 4	0.017	0.017	0.0063	0.0063
Chloroform	0.0055 :	0.0055	1 / 4	0.007	0.007	0.0038	0.0038
Ethylbenzene	0.0055 :	0.029	1 / 5	0.002	0.002	0.005	0.002
Tetrachloroethene (PCE)	0.0055 :	0.0055	4 / 5	0.0008	0.014	0.0039	0.0039
Toluene	0.0055 :	0.0055	2 / 4	0.0008	0.03	0.0091	0.0091
Trichloroethene (TCE)	0.0055 :	0.0055	1 / 4	0.022	0.022	0.0076	0.0076
Xylenes, Total	0.0055 :	0.0055	1 / 4	0.085	0.085	0.0233	0.0233
SVOCs (mg/Kg)							
Di-n-octylphthalate	0 :	0	5 / 5	0.1	0.37	0.252	0.252
Indeno (1,2,3-cd)Pyrene	0.69 :	0.96	2 / 5	0.28	0.96	0.486	0.486
N-Nitrosodiphenylamine	0.69 :	0.96	2 / 4	0.33	0.36	0.3788	0.36
Pyrene	0.69 :	0.73	1 / 4	0.14	0.14	0.3038	0.14
bis(2-EthylHexyl)phthalate	0 :	0	5 / 5	210	1200	602	602
Metals (mg/Kg)							
Arsenic	0 :	0	5 / 5	0.9	5.5	3.82	3.82
Barium	0 :	0	5 / 5	5.6	12	7.1	7.1
Calcium	0 :	0	5 / 5	400	5900	1814	1814
Chromium	0 :	0	5 / 5	4.2	6.6	5.9	5.9
Cobalt	1.5 :	1.5	2 / 4	1.9	3	1.6	1.6

TABLE 32
SUBSURFACE SOIL EXPOSURE POINT CONCENTRATIONS - PLANT B AREA HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
Copper	2.5 :	2.5	4 / 5	2.6	6	3.09	3.09
Iron	0 :	0	5 / 5	2100	5900	4000	4000
Manganese	0 :	0	5 / 5	30	59	37.6	37.6
Nickel	4 :	4	3 / 4	4.1	5.5	3.975	3.975
Potassium	0 :	0	5 / 5	380	700	492	492
Sodium	0 :	0	5 / 5	26	130	78.4	78.4
Vanadium	2.5 :	2.5	4 / 5	4.2	8.6	4.91	4.91
Inorganics (mg/Kg)							
Chloride	40 :	40	1 / 4	56	56	29	29
Nitrogen, Ammonia	8 :	8	1 / 4	10	10	5.5	5.5
Sulfate as SO4	20 :	20	4 / 5	22	120	47.6	47.6

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 2.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
The median represents the median value of all sample results, including non-detects, with the SQL used as the value for non-detects.
3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 33
SUBSURFACE SOIL EXPOSURE POINT CONCENTRATIONS - SULFATE LANDFILL

Olin Corporation
Wilmington, MA Facility

OHM of Concern[1]	Site Data/Concentration[2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC[3]
SVOCs (mg/Kg)							
bis(2-EthylHexyl)phthalate	0	0	1 / 1	1.2	1.2	1.2	1.2
Metals (mg/Kg)							
Arsenic	0	0	1 / 1	0.0062	0.0062	0.0062	0.0062
Barium	0	0	1 / 1	0.015	0.015	0.015	0.015
Calcium	0	0	1 / 1	6.9	6.9	6.9	6.9
Chromium	0	0	1 / 1	0.01	0.01	0.01	0.01
Cobalt	0	0	1 / 1	0.0021	0.0021	0.0021	0.0021
Copper	0	0	1 / 1	0.0082	0.0082	0.0082	0.0082
Iron	0	0	1 / 1	6.9	6.9	6.9	6.9
Manganese	0	0	1 / 1	0.06	0.06	0.06	0.06
Nickel	0	0	1 / 1	0.0062	0.0062	0.0062	0.0062
Potassium	0	0	1 / 1	0.25	0.25	0.25	0.25
Sodium	0	0	1 / 1	0.27	0.27	0.27	0.27
Vanadium	0	0	1 / 1	0.013	0.013	0.013	0.013
Inorganics (mg/Kg)							
Chloride	0	0	1 / 1	0.36	0.36	0.36	0.36
Nitrogen, Ammonia	0	0	1 / 1	0.64	0.64	0.64	0.64
Sulfate as SO4	0	0	1 / 1	28000	28000	28000	28000

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 2.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
The median represents the median value of all sample results, including non-detects, with the SQL used as the value for non-detects.
3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum

TABLE 33
SUBSURFACE SOIL EXPOSURE POINT CONCENTRATIONS - SULFATE LANDFILL

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	

detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.

EPC = Exposure Point Concentration

OHM = Oil or Hazardous Material

SQL = Sample Quantitation Limit

MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 34
SUBSURFACE SOIL EXPOSURE POINT CONCENTRATIONS - SITE AREA
(EXCLUDING HOT SPOTS AND SULFATE LANDFILL)

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
VOCs (mg/Kg)							
2,4,4-Trimethyl-1-pentene	0.01 :	0.011	18 / 21	0.003	7	0.6929	0.6929
2,4,4-Trimethyl-2-Pentene	0.01 :	0.012	15 / 21	0.002	5.1	0.4963	0.4963
2-Butanone (MEK)	0.015 :	0.021	9 / 22	0.0006	0.01	0.0061	0.0061
2-Hexanone	0.0027 :	0.1	7 / 22	0.001	3.8	0.1843	0.1843
4-Methyl-2-Pentanone (MIBK)	0.0027 :	0.1	2 / 22	0.005	0.015	0.0101	0.0101
Acetone	0.0027 :	0.1	3 / 22	0.016	0.12	0.017	0.017
Benzene	0.0009 :	0.007	2 / 22	0.0005	0.012	0.003	0.003
Carbon Disulfide	0.0018 :	0.07	1 / 22	0.001	0.001	0.0065	0.001
Chloroform	0.0009 :	0.035	1 / 22	0.001	0.001	0.0033	0.001
Ethylbenzene	0.005 :	0.007	4 / 22	0.0019	2.3	0.1075	0.1075
Styrene	0.0009 :	0.035	3 / 22	0.0005	3.3	0.1531	0.1531
Tetrachloroethene (PCE)	0.0009 :	0.035	3 / 22	0.0008	0.001	0.0031	0.001
Toluene	0.005 :	0.007	14 / 22	0.0005	4.8	0.2208	0.2208
Trichloroethene (TCE)	0.0009 :	0.007	1 / 22	0.01	0.01	0.003	0.003
Xylenes, Total	0.005 :	0.035	2 / 22	0.0011	0.035	0.0049	0.0049
SVOCs (mg/Kg)							
Benzo(a)Anthracene	0.012 :	1.2	1 / 19	0.048	0.048	0.3473	0.048
Benzo(b)Fluoranthene	0.012 :	1.2	1 / 19	0.049	0.049	0.3474	0.049
Butylbenzylphthalate	0.012 :	0.92	3 / 19	0.05	0.13	0.3019	0.13
Chrysene	0.012 :	1.2	1 / 19	0.057	0.057	0.3478	0.057
Di-n-octylphthalate	0.012 :	1.2	3 / 19	0.023	0.31	0.3378	0.31
Diethylphthalate	0.012 :	1.2	2 / 19	0.046	0.057	0.326	0.057
N-Nitroso-di-n-propylamine	0.69 :	1.2	1 / 19	1.6	1.6	0.4468	0.4468
N-Nitrosodiphenylamine	0.012 :	1.2	1 / 19	0.41	0.41	0.3664	0.3664
Phenol	0.69 :	1.2	1 / 19	5.3	5.3	0.6416	0.6416
Pyrene	0.012 :	1.2	2 / 19	0.043	0.17	0.3368	0.17
bis(2-EthylHexyl)phthalate	0.012 :	2.5	10 / 21	0.1	3.4	0.8379	0.8379

TABLE 34
SUBSURFACE SOIL EXPOSURE POINT CONCENTRATIONS - SITE AREA
(EXCLUDING HOT SPOTS AND SULFATE LANDFILL)

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
Metals (mg/Kg)							
Arsenic	2 :	2	18 / 19	0.0046	18	5.7318	5.7318
Barium	0 :	0	20 / 20	0.09	75	16.8645	16.8645
Cadmium	1 :	1	5 / 19	0.0048	1.3	0.6003	0.6003
Calcium	0 :	0	20 / 20	1.2	1900	728.06	728.06
Chromium	0 :	0	20 / 20	0.028	230	29.7864	29.7864
Cobalt	1.5 :	1.5	15 / 20	0.0017	4.1	1.9926	1.9926
Copper	2.5 :	2.5	17 / 20	0.0056	14	4.9728	4.9728
Iron	0 :	0	20 / 20	6.8	12000	6194.34	6194.34
Manganese	0 :	0	20 / 20	0.044	340	71.1872	71.1872
Mercury	0.1 :	0.13	1 / 18	0.0001	0.0001	0.0483	0.0001
Nickel	4 :	4	15 / 19	0.0047	11	5.1476	5.1476
Potassium	0 :	0	20 / 20	0.26	1800	739.013	739.013
Silver	0.0015 :	1.5	1 / 18	4.5	4.5	0.9167	0.9167
Sodium	0 :	0	20 / 20	0.25	440	88.4625	88.4625
Inorganics (mg/Kg)							
Chloride	40 :	40	9 / 18	0.26	170	44.5144	44.5144
Nitrogen, Ammonia	8 :	8	15 / 19	0.49	400	45.8311	45.8311
Sulfate as SO4	20 :	27	13 / 20	23	360	74.475	74.475

Notes:

1 Selection of OHM of Concern for this medium is presented in Table 2.

2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
The median represents the median value of all sample results, including non-detects, with the SQL used as the value for non-detects.

3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum

TABLE 34
SUBSURFACE SOIL EXPOSURE POINT CONCENTRATIONS - SITE AREA
(EXCLUDING HOT SPOTS AND SULFATE LANDFILL)

Olin Corporation
Wilmington, MA Facility

	Site Data/Concentration [2]						
	Minimum	Maximum	Frequency of			Arithmetic	
OHM of Concern [1]	SQL	SQL	Detection	Minimum	Maximum	Mean	EPC [3]

detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.

EPC = Exposure Point Concentration

OHM = Oil or Hazardous Material

SQL = Sample Quantitation Limit

MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 35
SUMMARY SUBSURFACE SOIL EXPOSURE POINT CONCENTRATIONS - FUTURE LAND USE

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	EPCs for Exposure Points [2]						Area-Weighted EPCs for Exposure Points[3]						EPC
	EP 17	EP 11	EP 12	EP 13	EP 14	EP 15	EP 17	EP 11	EP 12	EP 13	EP 14	EP 15	Total Site [5]
			Fraction of Site Area [4] :				0.81	0.024	0.0089	0.021	0.11	0.03	
VOCs (mg/Kg)													
1,2-Dichloroethane	0	0	0	0.082	0	0.01	0	5E-05	0	0.001722	0	0.00032	0.0021
2,4,4-Trimethyl-1-pentene	0.69	32.3	0	120.5	0.38	0.72	0.5612	0.776	0	2.5305	0.041	0.02171	3.93
2,4,4-Trimethyl-2-Pentene	0.5	20.1	0	31.2	0.11	0.26	0.402	0.482	0	0.6552	0.012	0.00773	1.56
2-Butanone (MEK)	0.01	0.02	0.003	0.099	0.06	0.01	0.0049	5E-04	3.03E-05	0.002079	0.006	0.00029	0.014
2-Hexanone	0.18	0.01	0	0.9	0.06	0.04	0.1493	2E-04	0	0.0189	0.007	0.00113	0.18
4-Methyl-2-Pentanone (MIBK)	0.01	0	0.5	0.76	0	0.01	0.0082	0	0.00445	0.01596	0	0.00038	0.029
Acetone	0.02	0.06	230	1.8	1.82	0.03	0.0138	0.001	2.047	0.0378	0.2	0.00086	2.30
Benzene	0	0	1.27	0.035	0.01	0	0.0024	5E-05	0.011303	0.000735	0.002	0	0.016
Carbon Disulfide	0	0.01	0	0.66	0	0	0.0008	2E-04	0	0.01386	0	0	0.0149
Carbon Tetrachloride	0	0	0	0	0	0	0	7E-05	0	0	0	0.00013	0.00020
Chlorobenzene	0	0.06	0.287	0.041	0	0.01	0	0.001	0.002554	0.000861	0	0.00019	0.0049
Chloroform	0	0	0	0	0	0	0.0008	2E-05	0	0	2E-04	0.00011	0.0012
Ethylbenzene	0.11	0.07	0.107	0.215	0	0	0.0871	0.002	0.000952	0.004515	0	0.00006	0.094
Methylene Chloride	0	0.01	0.256	0.35	0.21	0	0	2E-04	0.002278	0.00735	0.023	0	0.033
Styrene	0.15	0.01	0	0	0	0	0.124	3E-04	0	0	0	0	0.12
Tetrachloroethene (PCE)	0	0	0	0	0	0	0.0008	1E-04	0	0	1E-04	0.00012	0.0012
Toluene	0.22	0.13	4.33	0.579	0.02	0.01	0.1788	0.003	0.038537	0.012159	0.002	0.00027	0.24
Trichloroethene (TCE)	0	0	0	0	0.01	0.01	0.0024	0	0	0	0.001	0.00023	0.0041
Xylenes, Total	0	0.03	0.567	0.3097	0	0.02	0.004	8E-04	0.005046	0.006504	0	0.0007	0.017
SVOCs (mg/Kg)													
1,2,3-Trichlorobenzene			1.4	0			0	0	0.01246	0	0	0	0.0125
1,2,4-Trichlorobenzene	0	0.45	0.35	0	0.09	0	0	0.011	0.003115	0	0.009	0	0.023
1,2-Dichlorobenzene	0	0.49	2.01	0	0	0	0	0.012	0.017889	0	0	0	0.030
1,3-Dichlorobenzene	0	0.29	0	0	0	0	0	0.007	0	0	0	0	0.0070
1,4-Dichlorobenzene	0	0.54	2.43	0	0	0	0	0.013	0.021627	0	0	0	0.035
2,4-Dimethylphenol	0	0	1.63	0	0	0	0	0	0.014507	0	0	0	0.015

TABLE 35
SUMMARY SUBSURFACE SOIL EXPOSURE POINT CONCENTRATIONS - FUTURE LAND USE

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	EPCs for Exposure Points [2] EP 17	EP 11	EP 12	EP 13	EP 14	EP 15	Area-Weighted EPCs for Exposure Points [3] EP 17	EP 11	EP 12	EP 13	EP 14	EP 15	EPC Total Site [5]
			Fraction of Site Area [4] :				0.81	0.024	0.0089	0.021	0.11	0.03	
2-Methylnaphthalene	0	0.06	0	0	0	0	0	0.002	0	0	0	0	0.0015
2-Methylphenol (o-Cresol)	0	0	3.8	0	0	0	0	0	0.03382	0	0	0	0.034
4-Bromophenyl-phenylether		0.48	0	0			0	0.012	0	0	0	0	0.012
4-Chlorophenyl-phenylether	0	0.5	0	0	0	0	0	0.012	0	0	0	0	0.012
4-Methylphenol(p-Cresol)	0	0	4.3	0.038	0	0	0	0	0.03827	0.000798	0	0	0.04
Anthracene	0	0	0	0	0.03	0	0	0	0	0	0.003	0	0.0031
Benzo(a)Anthracene	0.05	0.05	0	0	0.08	0	0.0389	0.001	0	0	0.009	0	0.049
Benzo(a)Pyrene	0	0	0	0	0.06	0	0	0	0	0	0.006	0	0.0061
Benzo(b)Fluoranthene	0.05	0.05	0	0	0.08	0	0.0397	0.001	0	0	0.009	0	0.050
Butylbenzylphthalate	0.13	0.89	0	1.1	0.04	0	0.1053	0.021	0	0.0231	0.004	0	0.15
Chrysene	0.06	0.09	0	0	0.09	0	0.0462	0.002	0.002047	0.04557	0.009	0	0.1054
Di-n-butylphthalate	0	4.43	0.23	2.17	0	0	0	0.106	0.002047	0.04557	0	0	0.15
Di-n-octylphthalate	0.31	0.2	0.88	0.2	0.07	0.25	0.2511	0.005	0.007832	0.0042	0.008	0.00756	0.28
Dibenzofuran	0	0.4	0.39	0	0	0	0	0.009	0.003471	0	0	0	0.013
Diethylphthalate	0.06	0	0	0	0	0	0.0462	0	0	0	0	0	0.046
Fluoranthene	0	0.08	0	0	0.16	0	0	0.002	0	0	0.018	0	0.020
Hexachlorobenzene	0	0.24	0	0	0	0	0	0.006	0	0	0	0	0.0058
Indeno (1,2,3-cd)Pyrene	0	0	0	5.66	0	0.49	0	0	0	0.11886	0	0.01458	0.13
Isophorone	0	0	0	1.63	0	0	0	0	0	0.03423	0	0	0.034
N-Nitroso-di-n-propylamine	0.45	0	0	0	0	0	0.3619	0	0	0	0	0	0.36
N-Nitrosodiphenylamine	0.37	374	1.5	4746	0.4	0.36	0.2968	8.987	0.01335	99.666	0.044	0.0108	109.0
Naphthalene	0	0.34	3.43	0.077	0.39	0	0	0.008	0.030527	0.001617	0.043	0	0.08
Phenanthrene	0	0.34	0	0	0.12	0	0	0.008	0	0	0.013	0	0.021
Phenol	0.64	0.25	170	1	0.1	0	0.5197	0.006	1.513	0.021	0.011	0	2.07
Pyrene	0.17	0.2	0	0	0.13	0.14	0.1377	0.005	0	0	0.014	0.0042	0.16
bis(2-EthylHexyl)phthalate	0.84	903	368	24.2	4.86	602	0.6787	21.67	3.2752	0.5082	0.535	18.06	44.7

TABLE 35
SUMMARY SUBSURFACE SOIL EXPOSURE POINT CONCENTRATIONS - FUTURE LAND USE

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	EPCs for Exposure Points [2] EP 17	EP 11	EP 12	EP 13	EP 14	EP 15	Area-Weighted EPCs for Exposure Points[3] EP 17	EP 11	EP 12	EP 13	EP 14	EP 15	EPC Total Site [5]
			Fraction of Site Area [4]:				0.81	0.024	0.0089	0.021	0.11	0.03	
Pesticides/PCBs (mg/Kg)													
4,4'-DDD	0	0.02	0	0	0	0	0	5E-04	0	0	0	0	0.00053
Aldrin	0	0.01	0	0	0	0	0	3E-04	0	0	0	0	0.00030
Alpha-BHC	0	0.01	0	0	0	0	0	3E-04	0	0	0	0	0.00028
Alpha-Chlordane	0	0	0	1.095	0	0	0	0	0	0.022995	0	0	0.0230
Endosulfan I	0	0	0.021	0	0	0	0	0	0.00019	0	0	0	0.00019
Endosulfan Sulfate	0	0.04	0	0	0	0	0	9E-04	0	0	0	0	0.00090
Endrin	0	0.03	0	0	0	0	0	7E-04	0	0	0	0	0.00069
Endrin Ketone	0	0	0	0	0.02	0	0	0	0	0	0.002	0	0.0022
Gamma-BHC (Lindane)	0	0	0	0	0.01	0	0	0	0	0	0.001	0	0.0014
Methoxychlor	0	0	0	1.095	0	0	0	0	0	0.022995	0	0	0.0230
Toxaphene	0	0	0	2.18	0	0	0	0	0	0.04578	0	0	0.046
Metals (mg/Kg)													
Antimony	0	9.28	0	0	0	0	0	0.223	0	0	0	0	0.22
Arsenic	5.73	4.01	0.47	1.85	10.2	3.82	4.6428	0.096	0.004183	0.03885	1.122	0.1146	6.02
Barium	16.9	22.3	2.07	10.25	25.7	7.1	13.66	0.535	0.018423	0.21525	2.823	0.213	17.5
Cadmium	0.6	0.55	0.43	0.972	1.02	0	0.4862	0.013	0.003827	0.020412	0.112	0	0.64
Calcium	728	795	688	10814	5180	1814	589.73	19.07	6.1232	227.094	569.8	54.42	1466
Chromium	29.8	2316	1.88	21.1	46	5.9	24.127	55.59	0.016732	0.4431	5.063	0.177	85.4
Cobalt	1.99	2.64	0	1.75	4.03	1.6	1.614	0.063	0	0.03675	0.443	0.048	2.20
Copper	4.97	8.82	6	14.6	12.8	3.09	4.028	0.212	0.0534	0.3066	1.411	0.0927	6.10
Cyanide	0	2	0	0	0	0	0	0.048	0	0	0	0	0.048
Iron	6194	7055	647	16849	9764	4000	5017.4	169.3	5.7583	353.829	1074	120	6740
Manganese	71.2	62.7	6.05	94.3	157	37.6	57.662	1.505	0.053845	1.9803	17.22	1.128	79.6
Mercury	0	0.13	9E-04	0.0002	0	0	8E-05	0.003	8.01E-06	4.2E-06	0	0	0.0032
Nickel	5.15	5.81	8.33	9.15	10.9	3.98	4.1696	0.139	0.074137	0.19215	1.203	0.11925	5.90
Potassium	739	639	73.4	224	1263	492	598.6	15.34	0.65326	4.704	138.9	14.76	773

TABLE 35
SUMMARY SUBSURFACE SOIL EXPOSURE POINT CONCENTRATIONS - FUTURE LAND USE

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	EPCs for Exposure Points [2] EP 17	EP 11	EP 12	EP 13	EP 14	EP 15	Area-Weighted EPCs for Exposure Points[3] EP 17	EP 11	EP 12	EP 13	EP 14	EP 15	EPC Total Site [5]
		Fraction of Site Area [4] :					0.81	0.024	0.0089	0.021	0.11	0.03	
Silver	0.92	0	0	0	0	0	0.7425	0	0	0	0	0	0.74
Sodium	88.5	101	2867	120	121	78.4	71.655	2.428	25.5163	2.52	13.32	2.352	118
Vanadium		13.3	11.7	7.84	13.7	4.91	0	0.319	0.10413	0.16464	1.503	0.1473	2.24
Inorganics (mg/Kg)													
Chloride	44.5	34.4	0.12	11.78	47.8	29	36.057	0.825	0.001068	0.24738	5.258	0.87	43.3
Nitrogen, Ammonia	45.8	1028	0.074	0.5975	68.3	5.5	37.123	24.68	0.000654	0.012548	7.517	0.165	69.5
Sulfate as SO4	74.5	65.1	14675	3100	6199	47.6	60.325	1.562	130.6075	65.1	681.9	1.428	941

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 2.
2 EPCs for each exposure point in this medium are presented in the subsurface soil exposure point concentration tables.
3 EPCs calculated by multiplying the EPC for the exposure point by the fractional site area of that exposure point.
4 Fractional site area represents the area of the exposure point divided by the area of the entire site (excluding sulfate landfill). (see subsurface soil exposure point figure).
5 The final area-weighted EPC is the sum of the area-weighted EPCs for each exposure point.
"0" indicates that OHM was not detected in samples collected at exposure point.
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

EP17 - Site Area (excluding hot spots and sulfate landfill)
EP15 - Plant B area hot spot
EP11 - Lake Poly hot spot
EP12 - Drum Area B hot spot
EP13 - Drum Area A hot spot
EP14 - Former Lagoon Area hot spot

TABLE 36
CURRENT SHALLOW GROUNDWATER EXPOSURE POINT CONCENTRATIONS FOR THE VAPOR INTRUSION MODEL

Olin Corporation
Wilmington, MA Facility

OHM of Concern[1]	Groundwater EPC[2]	Building Air EPC[3] (ug/m^3)
VOCs (mg/L)		
1,1,1-Trichloroethane	0.002	1.7e-04
1,1-Dichloroethane	0.002	5.6e-05
2,4,4-Trimethyl-1-pentene	0.17	8.82
2,4,4-Trimethyl-2-Pentene	0.036	1.87
2-Hexanone	0.009	1.27e-06
Acetone	0.013	2.55e-06
Bromoform	0.006	1.75e-05
Dibromochloromethane	0.002	8.76E-06
Methylene Chloride	0.003	3.32E-05

Notes:

1 OHM of Concern represent analytes detected in shallow groundwater samples collected after 1/1/95.

2 The EPC is the maximum detected concentration.

3 The building air EPC is calculated in Attachment 5.

EPC = Exposure Point Concentration

OHM = Oil or Hazardous Material

MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 37
NON-ZONE II GROUNDWATER EXPOSURE POINT CONCENTRATIONS
SHALLOW GROUNDWATER HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Groundwater EPC [3]	Building Air EPC [4] (ug/m^3)
VOCs (mg/L)								
1,1,1-Trichloroethane	0.005 :	0.01	2 / 17	0.002	0.019	0.0036	0.019	2.89E-03
1,1-Dichloroethane	0.005 :	0.01	3 / 17	0.0008	0.006	0.0027	0.006	3.00E-04
1,1-Dichloroethene	0.005 :	0.01	1 / 17	0.003	0.003	0.0027	0.003	6.97E-04
2,4,4-Trimethyl-1-pentene	0.005 :	0.01	14 / 19	0.002	3.5	0.2589	3.5	3.22E+02
2,4,4-Trimethyl-2-Pentene	0.005 :	0.01	11 / 19	0.0007	1.2	0.0935	1.2	1.11E+02
2-Hexanone	0.01 :	0.02	1 / 17	0.009	0.009	0.0072	0.009	2.25E-06
Acetone	0.01 :	0.02	10 / 17	0.008	2	0.1883	2	6.97E-04
Bromoform	0.005 :	0.01	3 / 17	0.002	0.022	0.004	0.022	1.14E-04
Carbon Disulfide	0.005 :	0.01	1 / 17	0.009	0.009	0.0045	0.009	2.41E-03
Dibromochloromethane	0.005 :	0.01	2 / 17	0.002	0.007	0.0029	0.007	6.29E-01
Methylene Chloride	0.005 :	0.01	4 / 17	0.0008	0.003	0.0039	0.003	5.90E-05
Toluene	0.005 :	0.01	1 / 17	0.001	0.001	0.0026	0.001	5.90E-05
Inorganics (mg/L)								
Ammonia	0.04 :	0.1	31 / 33	1.02	220	51.1	220	6.29E-01

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 3.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
3 The EPC is the maximum detected concentration.
4 The building air EPC is calculated in Attachment 5.
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan

TABLE 37
NON-ZONE II GROUNDWATER EXPOSURE POINT CONCENTRATIONS
SHALLOW GROUNDWATER HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Groundwater EPC [3]	Building Air EPC [4] (ug/m^3)

(WSC/ORS-95-141, July).

TABLE 38
NON-ZONE II GROUNDWATER EXPOSURE POINT CONCENTRATIONS
DENSE LAYER HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Groundwater EPC [3]
	Site Data/Concentration [1]						
VOCs (mg/L)							
1,1,1-Trichloroethane	0.005 :	0.05	6 / 16	0.002	0.011	0.0064	0.0064
1,1-Dichloroethane	0.005 :	0.05	4 / 16	0.002	0.005	0.0049	0.0049
1,1-Dichloroethene	0.005 :	0.05	3 / 16	0.001	0.002	0.0045	0.002
1,2-Dichloroethane	0.005 :	0.05	14 / 16	0.002	0.027	0.0133	0.0133
2,4,4-Trimethyl-1-pentene	0.01 :	0.1	5 / 16	0.002	0.049	0.0133	0.0133
2,4,4-Trimethyl-2-Pentene	0.01 :	0.1	3 / 17	0.003	0.013	0.0121	0.0121
2-Butanone (MEK)	0.012 :	0.2	4 / 15	0.003	0.052	0.0188	0.0188
2-Hexanone	0.015 :	0.2	2 / 16	0.16	0.16	0.0345	0.0345
4-Methyl-2-Pentanone (MIBK)	0.015 :	0.2	3 / 16	0.001	0.004	0.0144	0.004
Acetone	0.015 :	0.3	12 / 16	0.04	0.92	0.207	0.207
Benzene	0.005 :	0.05	5 / 16	0.002	0.004	0.0048	0.004
Bromodichloromethane	0.005 :	0.05	12 / 16	0.002	0.043	0.0155	0.0155
Bromoform	0.005 :	0.005	15 / 16	0.002	0.75	0.1667	0.1667
Carbon Disulfide	0.01 :	0.1	14 / 16	0.003	0.051	0.0194	0.0194
Carbon Tetrachloride	0.005 :	0.05	5 / 16	0.001	0.016	0.0059	0.0059
Chloroform	0.005 :	0.005	15 / 16	0.002	0.094	0.0317	0.0317
Chloromethane(MethylChloride)	0.01 :	0.1	6 / 16	0.001	0.006	0.009	0.006
Dibromochloromethane	0.005 :	0.05	13 / 16	0.003	0.17	0.0439	0.0439
Ethylbenzene	0.005 :	0.05	5 / 16	0.001	0.006	0.0049	0.0049
Methylene Chloride	0.008 :	0.1	6 / 16	0.003	0.013	0.0107	0.0107
Tetrachloroethene (PCE)	0.005 :	0.05	2 / 16	0.002	0.078	0.0095	0.0095
Toluene	0.005 :	0.005	14 / 16	0.008	0.081	0.0366	0.0366
Trichloroethene (TCE)	0.005 :	0.05	11 / 16	0.002	0.016	0.0051	0.0051

TABLE 38
NON-ZONE II GROUNDWATER EXPOSURE POINT CONCENTRATIONS
DENSE LAYER HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM	Site Data/Concentration [1] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Groundwater EPC [3]
Xylenes, Total	0.005 :	0.05	3 / 16	0.001	0.007	0.0053	0.0053
SVOCs (mg/L)							
1,2,4-Trichlorobenzene	0.01 :	0.01	3 / 15	0.001	0.007	0.0047	0.0047
1,2-Dichlorobenzene	0.01 :	0.01	1 / 15	0.002	0.002	0.0048	0.002
1,4-Dichlorobenzene	0.01 :	0.01	1 / 15	0.003	0.003	0.0049	0.003
2,4-Dichlorophenol	0.01 :	0.01	5 / 13	0.001	0.003	0.0037	0.003
2,6-Dinitrotoluene	0.01 :	0.01	1 / 15	0.005	0.005	0.005	0.005
2-Chlorophenol	0.01 :	0.01	6 / 14	0.001	0.003	0.0036	0.003
2-Methylphenol (o-Cresol)	0.01 :	0.01	9 / 14	0.002	0.02	0.0055	0.0055
2-Nitrophenol	0.01 :	0.01	13 / 14	0.001	0.21	0.082	0.082
4-Bromophenyl-phenylether	0.01 :	0.01	8 / 15	0.001	0.034	0.0067	0.0067
4-Chlorophenyl-phenylether	0.01 :	0.01	3 / 15	0.002	0.015	0.0053	0.0053
4-Methylphenol(p-Cresol)	0.01 :	0.01	10 / 15	0.002	0.081	0.0189	0.0189
4-Nitrophenol	0 :	0	15 / 15	0.003	0.33	0.1177	0.1177
.Benzoic Acid	0.05 :	0.05	7 / 15	0.002	0.043	0.0209	0.0209
Benzyl Alcohol	0.01 :	0.01	8 / 15	0.002	0.009	0.0048	0.0048
Di-n-butylphthalate	0.01 :	0.01	3 / 16	0.0004	0.009	0.0048	0.0048
Dibenzofuran	0.01 :	0.01	2 / 15	0.001	0.002	0.0045	0.002
Isophorone	0.01 :	0.01	4 / 15	0.002	0.008	0.0047	0.0047
N-Nitrosodiphenylamine	0.01 :	0.01	5 / 16	0.001	0.005	0.0043	0.0043
Naphthalene	0.01 :	0.01	15 / 16	0.0002	0.088	0.0266	0.0266
Phenol	0.01 :	0.01	13 / 16	0.003	1.2	0.3474	0.3474
bis(2-EthylHexyl)phthalate	0.01 :	0.01	5 / 16	0.001	0.006	0.0044	0.0044

TABLE 38
NON-ZONE II GROUNDWATER EXPOSURE POINT CONCENTRATIONS
DENSE LAYER HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM	Site Data/Concentration [1] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Groundwater EPC [3]
Pesticides/PCBs (mg/L)							
Alpha-BHC	0.00005 :	0.0005	9 / 15	9.4E-05	0.0003	0.000137	0.000136867
Beta-BHC	0.00005 :	0.0005	4 / 15	5.9E-05	0.00012	7.92E-05	0.0000792
Delta-BHC	0.00005 :	0.0005	1 / 15	0.0027	0.0027	0.000227	0.000226667
Gamma-BHC (Lindane)	0.00005 :	0.0005	2 / 14	5.8E-05	0.000085	7.27E-05	7.27143E-05
Heptachlor Epoxide	0.00005 :	0.0005	1 / 15	5.1E-05	0.000051	6.51E-05	0.000051
Metals (mg/L)							
Aluminum	0 :	0	5 / 5	43	2400	1036.6	1036.6
Barium	0.05 :	0.1	2 / 5	0.14	0.19	0.086	0.086
Beryllium	0.015 :	0.015	1 / 2	0.084	0.084	0.0458	0.0458
Cadmium	0 :	0	2 / 2	0.022	0.19	0.106	0.106
Calcium	0 :	0	5 / 5	290	590	378	378
Chromium	0 :	0	12 / 12	0.52	2800	751.2267	751.2267
Cobalt	0 :	0	2 / 2	0.32	3	1.66	1.66
Copper	0 :	0	2 / 2	0.13	2.8	1.465	1.465
Cyanide	0.02 :	0.02	1 / 2	0.026	0.026	0.018	0.018
Iron	0 :	0	5 / 5	440	3600	1448	1448
Lead	0.05 :	0.25	2 / 5	0.087	0.17	0.0914	0.0914
Magnesium	0 :	0	5 / 5	96	1600	685.2	685.2
Manganese	0 :	0	5 / 5	13	580	205.8	205.8
Mercury	0.0002 :	0.0002	1 / 2	0.0009	0.0009	0.0005	0.0005
Nickel	0 :	0	2 / 2	0.19	4.2	2.195	2.195

TABLE 38
NON-ZONE II GROUNDWATER EXPOSURE POINT CONCENTRATIONS
DENSE LAYER HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM	Site Data/Concentration [1]						Groundwater EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
Potassium	0	0	5 / 5	16	110	57	57
Sodium	0	0	5 / 5	1700	22000	10880	10880
Vanadium	0	0	2 / 2	0.1	1.4	0.75	0.75
Zinc	0	0	2 / 2	0.24	14	7.12	7.12
Inorganics (mg/L)							
Chloride	0	0	31 / 31	820	91000	13316.77	13316.7742
Nitrate as N	0	0	5 / 5	3.1	22	14.42	14.42
Nitrite as N	0.05	0.05	3 / 4	0.17	0.33	0.1763	0.1763
Nitrogen, Ammonia	0	0	35 / 35	0.81	7000	1542.009	1542.0089
Sulfate as SO4	0	0	32 / 32	3700	87000	39853.13	39853.125

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 3.
2 Samples included in Site Data set are presented in Attachment 1.
. Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
3 The EPC is the arithmetic mean concentration unless the maximum detected concentration is less than the mean concentration, in which case the maximum detected concentration is the EPC.
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 39
NON-ZONE II GROUNDWATER EXPOSURE POINT CONCENTRATIONS
GROUNDWATER EXCLUDING HOT SPOTS

Olin Corporation
Wilmington, MA Facility

OHM	Site Data/Concentration [1] Minimum SQL : Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Groundwater EPC [3]
VOCs (mg/L)						
1,1,1-Trichloroethane	0.005 : 0.005	2 / 43	0.001	0.002	0.0025	0.002
1,1-Dichloroethane	0.005 : 0.3	2 / 43	0.003	0.004	0.006	0.004
1,2-Dichloroethane	0.005 : 0.005	1 / 43	0.004	0.004	0.0025	0.0025
2,4,4-Trimethyl-1-pentene	0.005 : 0.01	12 / 46	0.003	0.42	0.0263	0.0263
2,4,4-Trimethyl-2-Pentene	0.005 : 0.01	10 / 46	0.002	0.13	0.0114	0.0114
Acetone	0.01 : 0.027	17 / 43	0.001	13	0.4764	0.4764
Bromoform	0.005 : 0.005	2 / 43	0.002	0.007	0.0026	0.0026
Carbon Disulfide	0.005 : 0.01	1 / 43	0.003	0.003	0.0047	0.003
Carbon Tetrachloride	0.005 : 0.005	1 / 41	0.008	0.008	0.0026	0.0026
Chloroform	0.005 : 0.005	1 / 43	0.005	0.005	0.0026	0.0026
Methylene Chloride	0.002 : 0.01	5 / 42	0.002	0.003	0.0043	0.003
Tetrachloroethene (PCE)	0.002 : 0.005	3 / 43	0.001	0.001	0.0024	0.001
Toluene	0.005 : 0.005	2 / 43	0.001	0.002	0.0025	0.002
Trichloroethene (TCE)	0.005 : 0.005	1 / 43	0.008	0.008	0.0026	0.0026
Xylenes, Total	0.005 : 0.005	1 / 43	0.001	0.001	0.0025	0.001
SVOCs (mg/L)						
1,2,4-Trichlorobenzene	0.01 : 0.012	1 / 39	0.002	0.002	0.005	0.002
1,2-Dichlorobenzene	0.01 : 0.012	2 / 39	0.003	0.003	0.0049	0.003
1,3-Dichlorobenzene	0.01 : 0.012	2 / 39	0.001	0.001	0.0048	0.001
1,4-Dichlorobenzene	0.01 : 0.012	2 / 39	0.003	0.003	0.0049	0.003
2,6-Dinitrotoluene	0.01 : 0.012	1 / 39	0.001	0.001	0.0049	0.001
2-Nitrophenol	0.01 : 0.012	2 / 39	0.001	0.01	0.0051	0.0051
4-Bromophenyl-phenylether	0.01 : 0.012	1 / 39	0.006	0.006	0.0051	0.0051
4-Chlorophenyl-phenylether	0.01 : 0.012	2 / 38	0.001	0.004	0.0049	0.004
4-Nitrophenol	0.025 : 0.06	6 / 39	0.001	0.013	0.0119	0.0119

TABLE 39
NON-ZONE II GROUNDWATER EXPOSURE POINT CONCENTRATIONS
GROUNDWATER EXCLUDING HOT SPOTS

Olin Corporation
Wilmington, MA Facility

OHM	Site Data/Concentration [1] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Groundwater EPC [3]
Benzoic Acid	0.05 :	0.06	2 / 39	0.001	0.006	0.024	0.006
Benzyl Alcohol	0.01 :	0.012	1 / 39	0.002	0.002	0.005	0.002
Di-n-butylphthalate	0.01 :	0.012	2 / 41	0.0002	0.002	0.0048	0.002
Dibenzofuran	0.01 :	0.012	2 / 38	0.001	0.002	0.0048	0.002
Diethylphthalate	0.01 :	0.012	1 / 42	0.0003	0.0003	0.0049	0.0003
Isophorone	0.01 :	0.012	1 / 38	0.005	0.005	0.005	0.005
N-Nitrosodiphenylamine	0.01 :	0.012	11 / 42	0.004	0.67	0.0459	0.0459
Naphthalene	0.01 :	0.012	2 / 39	0.001	0.001	0.0048	0.001
Phenol	0.01 :	0.012	6 / 39	0.002	0.003	0.0046	0.003
bis(2-EthylHexyl)phthalate	0.01 :	0.014	7 / 41	0.001	0.01	0.0048	0.0048
Pesticides/PCBs (mg/L)							
Alpha-BHC	0.00005 :	0.00005	3 / 39	0.00005	0.000064	2.75E-05	2.75385E-05
Beta-BHC	0.00005 :	0.00005	1 / 39	0.00006	0.00006	2.59E-05	2.58974E-05
Delta-BHC	0.00005 :	0.00005	4 / 39	0.00005	0.00009	2.96E-05	2.9641E-05
Gamma-BHC (Lindane)	0.00005 :	0.00005	1 / 39	0.00011	0.00011	2.72E-05	2.71795E-05
Heptachlor Epoxide	0.00005 :	0.00005	3 / 39	5.2E-05	0.000068	2.78E-05	2.77949E-05
Metals (mg/L)							
Aluminum	0.1 :	0.1	2 / 5	0.68	12	2.566	2.566
Barium	0 :	0	5 / 5	0.016	0.077	0.0368	0.0368
Calcium	0 :	0	5 / 5	12	440	197.4	197.4
Chromium	0.015 :	0.015	9 / 33	0.021	3.6	0.1608	0.1608
Cobalt	0 :	0	1 / 1	0.021	0.021	0.021	0.021
Copper	0 :	0	1 / 1	0.36	0.36	0.36	0.36
Cyanide	0 :	0	1 / 1	0.053	0.053	0.053	0.053

TABLE 39
NON-ZONE II GROUNDWATER EXPOSURE POINT CONCENTRATIONS
GROUNDWATER EXCLUDING HOT SPOTS

Olin Corporation
Wilmington, MA Facility

OHM	Site Data/Concentration [1] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Groundwater EPC [3]
Iron	0.025 :	0.24	2 / 5	0.38	21	4.3185	4.3185
Magnesium	0 :	0	5 / 5	1.1	84	23.9	23.9
Manganese	0 :	0	5 / 5	0.061	10	3.0302	3.0302
Nickel	0 :	0	1 / 1	0.11	0.11	0.11	0.11
Potassium	0 :	0	5 / 5	1.9	26	9.3	9.3
Sodium	0 :	0	5 / 5	19	1200	315.4	315.4
Trivalent Chromium	0.015 :	0.015	1 / 4	0.037	0.037	0.0149	0.0149
Zinc	0 :	0	1 / 1	0.065	0.065	0.065	0.065
Inorganics (mg/L)							
Chloride	3 :	3	86 / 87	2.8	1500	164.5874	164.5874
Nitrate as N	0.14 :	0.32	2 / 4	0.42	4.4	1.2625	1.2625
Nitrogen, Ammonia	0.04 :	0.1	87 / 92	0.23	950	91.3237	91.3237
Sulfate as SO4	240 :	240	88 / 89	5.8	5800	681.2292	681.2292

Notes:
.1 Selection of OHM of Concern for this medium is presented in Table 3.
Although only VOCs were retained has OHMPC, the EPCs for all non-volatile OHM not screened out becaue of background or low frequency and concentration were presented in this table.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
3 The EPC is the arithmetic mean concentration unless the maximum detected concentration is less than the mean concentration, in which case the maximum detected concentration is the EPC.
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 40
ZONE II GROUNDWATER EXPOSURE POINT CONCENTRATIONS
PLANT B HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						Groundwater EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
VOCs (mg/L)							
2,4,4-Trimethyl-1-pentene	0.01 :	0.01	7 / 8	0.007	0.56	0.2161	0.56
2,4,4-Trimethyl-2-Pentene	0.01 :	0.01	7 / 8	0.002	0.16	0.058	0.16
2-Hexanone	0.01 :	0.08	1 / 8	2	2	0.2619	2
Acetone	0.01 :	0.1	3 / 8	0.026	0.66	0.1057	0.66
Ethylbenzene	0.005 :	0.03	1 / 8	0.047	0.047	0.0106	0.047
Methylene Chloride	0.005 :	0.05	1 / 8	0.006	0.006	0.0098	0.006
Toluene	0.005 :	0.05	2 / 8	0.001	0.018	0.008	0.018
Xylenes, Total	0.005 :	0.005	3 / 8	0.008	0.039	0.0123	0.039
SVOCS (mg/L)							
1,2-Dichlorobenzene	0.01 :	0.2	1 / 8	0.001	0.001	0.0208	0.001
1,4-Dichlorobenzene	0.01 :	0.2	1 / 8	0.002	0.002	0.0209	0.002
4-Chloroaniline	0.01 :	0.2	1 / 8	0.01	0.01	0.0219	0.01
4-Methylphenol(p-Cresol)	0.01 :	0.2	2 / 8	0.005	0.012	0.019	0.012
4-Nitrophenol	0.025 :	1	2 / 7	0.006	0.006	0.091	0.006
Benzoic Acid	0.05 :	1	1 / 7	0.003	0.003	0.0933	0.003
Di-n-butylphthalate	0.01 :	0.06	3 / 8	0.001	0.006	0.0079	0.006
Di-n-octylphthalate	0.01 :	0.2	1 / 8	6.4	6.4	0.8175	6.4
Dibenzofuran	0.01 :	0.2	2 / 8	0.002	0.002	0.0205	0.002
Diethylphthalate	0.01 :	0.06	1 / 8	0.011	0.011	0.0101	0.011
Fluorene	0.01 :	0.2	1 / 8	0.019	0.019	0.0199	0.019
Indeno (1,2,3-cd) pyrene	0.01 :	0.2	1 / 8	1.4	1.4	0.1925	1.4
N-Nitrosodiphenylamine	0 :	0	8 / 8	0.005	14	2.1063	14
Naphthalene	0.01 :	0.2	1 / 8	0.046	0.046	0.0233	0.046
Phenol	0.01 :	0.2	4 / 7	0.001	0.005	0.0181	0.005
bis(2-EthylHexyl)phthalate	0.01 :	0.01	5 / 8	0.002	190	23.7886	190

TABLE 40
ZONE II GROUNDWATER EXPOSURE POINT CONCENTRATIONS
PLANT B HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Minimum SQL : Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Groundwater EPC [3]
	Site Data/Concentration [2]					
Pesticides/PCBs (mg/L)						
Aldrin	0.00005 : 0.0007	2 / 8	0.000069	0.000077	7.763E-05	0.000077
Gamma BHC (Lindane)	0.00005 : 0.0007	1 / 7	0.000099	0.000099	0.000082	0.000099
Heptachlor epoxide	0.00005 : 0.0007	1 / 8	0.000013	0.000013	6.413E-05	0.000013
Metals (mg/L)						
Aluminum	0 : 0	1 / 1	0.36	0.36	0.36	0.36
Arsenic	0 : 0	1 / 1	0.035	0.035	0.035	0.035
Barium	0 : 0	1 / 1	0.019	0.019	0.019	0.019
Calcium	0 : 0	1 / 1	14	14	14	14
Chromium	0.01 : 0.015	1 / 6	0.018	0.018	0.0084	0.018
Copper	0 : 0	1 / 1	0.033	0.033	0.033	0.033
Iron	0 : 0	1 / 1	17	17	17	17
Magnesium	0 : 0	1 / 1	2.9	2.9	2.9	2.9
Manganese	0 : 0	1 / 1	0.53	0.53	0.53	0.53
Mercury	0 : 0	1 / 1	0.0003	0.0003	0.0003	0.0003
Potassium	0 : 0	1 / 1	2.7	2.7	2.7	2.7
Sodium	0 : 0	1 / 1	25	25	25	25
Zinc	0 : 0	1 / 1	0.43	0.43	0.43	0.43
Inorganics (mg/L)						
Chloride	0 : 0	11 / 11	5.1	60	34	60
Nitrogen, Ammonia	0 : 0	10 / 10	1.7	380	87.659	380
Sulfate as SO4	0 : 0	10 / 10	2.5	180	47.61	180

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 4.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.

TABLE 40
ZONE II GROUNDWATER EXPOSURE POINT CONCENTRATIONS
PLANT B HOT SPOT

Olin Corporation
Wilmington, MA Facility

	Site Data/Concentration [2]						
OHM of Concern [1]	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Groundwater EPC [3]

The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.

3 The EPC is the maximum detected concentration.

EPC = Exposure Point Concentration

OHM = Oil or Hazardous Material

SQL = Sample Quantitation Limit

MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 41
ZONE II GROUNDWATER EXPOSURE POINT CONCENTRATIONS
DENSE LAYER HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						Groundwater EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
VOCs (mg/L)							
1,2-Dichloroethane	0.005 :	0.005	5 / 6	0.001	0.02	0.0058	0.02
1,2-Dichloroethene(total)	0.005 :	0.005	3 / 6	0.002	0.093	0.0174	0.093
2,4,4-Trimethyl-2-Pentene	0.005 :	0.01	1 / 6	0.002	0.002	0.0041	0.002
2-Butanone (MEK)	0.01 :	0.015	2 / 6	0.011	0.027	0.0109	0.027
4-Methyl-2-Pentanone (MIBK)	0.01 :	0.015	2 / 6	0.003	0.003	0.0056	0.003
Acetone	0.015 :	0.015	4 / 6	0.018	0.37	0.1113	0.37
Benzene	0.005 :	0.005	4 / 6	0.002	0.011	0.0038	0.011
Bromodichloromethane	0.005 :	0.005	1 / 6	0.002	0.002	0.0024	0.002
Bromoform	0.005 :	0.005	2 / 6	0.004	0.014	0.0047	0.014
Carbon Disulfide	0.01 :	0.01	3 / 6	0.005	0.015	0.0082	0.015
Chlorobenzene	0.005 :	0.005	1 / 6	0.001	0.001	0.0023	0.001
Chloroform	0 :	0	6 / 6	0.004	0.079	0.0382	0.079
Dibromochloromethane	0.005 :	0.005	1 / 6	0.003	0.003	0.0026	0.003
Ethylbenzene	0.005 :	0.005	4 / 6	0.002	0.007	0.0038	0.007
Methylene Chloride	0.01 :	0.033	3 / 6	0.006	0.02	0.0101	0.02
Tetrachloroethene (PCE)	0.005 :	0.005	2 / 6	0.002	0.004	0.0027	0.004
Toluene	0 :	0	6 / 6	0.001	0.17	0.0782	0.17
Trichloroethene (TCE)	0 :	0	6 / 6	0.007	0.46	0.109	0.46
Vinyl Chloride	0.01	0.01	1 / 6	0.013	0.013	0.0063	0.013
Xylenes, Total	0.005 :	0.005	3 / 6	0.004	0.01	0.0051	0.01
SVOCs (mg/L)							
1,2-Dichlorobenzene	0.01 :	0.01	3 / 6	0.0003	0.001	0.0029	0.001
1,4-Dichlorobenzene	0.01 :	0.01	2 / 6	0.001	0.002	0.0038	0.002
2,4-Dichlorophenol	0.01 :	0.01	4 / 6	0.001	0.003	0.003	0.003
2-Methylphenol (o-Cresol)	0.01 :	0.01	4 / 6	0.002	0.017	0.007	0.017
2-Nitrophenol	0.01 :	0.01	2 / 6	0.032	0.045	0.0162	0.045

TABLE 41
ZONE II GROUNDWATER EXPOSURE POINT CONCENTRATIONS
DENSE LAYER HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						Groundwater EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
4-Methylphenol(p-Cresol)	0.01 :	0.01	4 / 6	0.002	0.051	0.0213	0.051
4-Nitrophenol	0.025 :	0.025	3 / 6	0.005	0.11	0.0376	0.11
Benzoic Acid	0.05 :	0.05	2 / 6	0.027	0.041	0.028	0.041
Benzyl Alcohol	0.01 :	0.01	4 / 6	0.002	0.006	0.004	0.006
Di-n-butylphthalate	0.01 :	0.01	1 / 6	0.0003	0.0003	0.0042	0.0003
Diethylphthalate	0.01 :	0.01	1 / 6	0.0004	0.0004	0.0042	0.0004
Naphthalene	0.01 :	0.01	4 / 6	0.0004	0.015	0.0067	0.015
Phenol	0.01 :	0.01	5 / 6	0.005	1.2	0.3588	1.2
bis(2-EthylHexyl)phthalate	0.01 :	0.01	1 / 6	0.0002	0.0002	0.0042	0.0002
Pesticides/PCBs (mg/L)							
Alpha-BHC	0.00005 :	0.00005	3 / 5	5.9E-05	0.000073	0.000064	0.000073
Metals (mg/L)							
Aluminum	0.1 :	0.1	2 / 3	0.63	990	330.2267	990
Arsenic	2.5 :	2.5	2 / 3	0.005	0.008	0.421	0.008
Barium	0.05 :	0.05	2 / 3	0.009	0.019	0.0177	0.019
Calcium	0 :	0	3 / 3	250	470	360	470
Chromium	0.015 :	0.015	4 / 5	0.023	790	159.0009	790
Iron	0 :	0	3 / 3	6.4	1800	627.1333	1800
Lead	0.005 :	0.005	2 / 3	0.007	0.1	0.0365	0.1
Magnesium	0 :	0	3 / 3	89	750	396.3333	750
Manganese	0 :	0	3 / 3	31	150	75.3333	150
Potassium	0 :	0	3 / 3	27	110	58.3333	110
Sodium	0 :	0	3 / 3	1100	10000	4400	10000
Inorganics (mg/L)							
Chloride	0 :	0	14 / 14	340	12000	4567.143	12000
Nitrate as N	0.05 :	0.05	2 / 3	14	24	12.675	24
Nitrite as N	0.05 :	0.05	1 / 3	0.17	0.17	0.0733	0.17

TABLE 41
ZONE II GROUNDWATER EXPOSURE POINT CONCENTRATIONS
DENSE LAYER HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						Groundwater EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
Nitrogen, Ammonia	0	0	17 / 17	2	4100	599.6118	4100
Sulfate as SO4	0	0	14 / 14	1000	48000	18393.57	48000

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 4.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
3 The EPC is the maximum detected concentration.
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 42
ZONE II GROUNDWATER EXPOSURE POINT CONCENTRATIONS
GROUNDWATER EXCLUDING HOT SPOTS

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						Groundwater EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
VOCs (mg/L)							
1,2-Dichloroethane	0.0002	: 0.02	3 / 29	0.0001	0.004	0.003	0.004
1,2-Dichloroethene(total)	0.005	: 0.005	8 / 27	0.002	0.43	0.0409	0.43
2,4,4-Trimethyl-1-pentene	0.005	: 0.02	7 / 28	0.002	0.012	0.005	0.012
2,4,4-Trimethyl-2-Pentene	0.005	: 0.02	4 / 28	0.003	0.006	0.0045	0.006
2-Hexanone	0.01	: 0.015	3 / 27	0.057	0.12	0.0165	0.12
4-Methyl-2-Pentanone (MIBK)	0.01	: 0.04	1 / 27	0.003	0.003	0.0075	0.003
Acetone	0.01	: 0.04	5 / 27	0.004	0.076	0.0104	0.076
Benzene	0.0004	: 0.02	7 / 29	0.0001	0.005	0.0029	0.005
Carbon Disulfide	0.005	: 0.02	1 / 27	0.001	0.001	0.0044	0.001
Chlorobenzene	0.0002	: 0.02	2 / 29	0.0002	0.001	0.0029	0.001
Ethylbenzene	0.005	: 0.05	2 / 27	0.002	0.004	0.004	0.004
Methylene Chloride	0.005	: 0.02	7 / 29	0.0009	0.002	0.004	0.002
Tetrachloroethene (PCE)	0.0002	: 0.02	2 / 28	0.001	0.004	0.0029	0.004
Toluene	0.005	: 0.02	3 / 27	0.002	0.17	0.0094	0.17
Trichloroethene (TCE)	0.005	: 0.02	8 / 29	0.0009	0.24	0.0156	0.24
Vinyl Chloride	0.0004	: 0.04	2 / 29	0.0002	0.002	0.0058	0.002
Xylenes, Total	0.005	: 0.02	1 / 27	0.017	0.017	0.0037	0.017
cis-1,2-Dichloroethene	0	: 0	2 / 2	0.0052	0.033	0.0191	0.033
trans-1,2-Dichloroethene	0.0002	: 0.0002	1 / 2	0.0003	0.0003	0.0002	0.0003
SVOCs (mg/L)							
1,4-Dichlorobenzene	0.01	: 0.01	1 / 26	0.001	0.001	0.0049	0.001
4-Nitrophenol	0.025	: 0.05	1 / 26	0.004	0.004	0.0179	0.004
Benzoic Acid	0.05	: 0.05	1 / 26	0.003	0.003	0.0242	0.003
Di-n-butylphthalate	0.01	: 0.01	11 / 27	0.0003	0.0009	0.0032	0.0009
Diethylphthalate	0.007	: 0.01	7 / 29	0.0002	0.005	0.0041	0.005
N-Nitrosodiphenylamine	0.01	: 0.01	4 / 27	0.001	0.011	0.005	0.011
Naphthalene	0.01	: 0.01	3 / 28	0.0002	0.002	0.0046	0.002
bis(2-EthylHexyl)phthalate	0.01	: 0.01	9 / 28	0.0002	0.012	0.0043	0.012

TABLE 42
ZONE II GROUNDWATER EXPOSURE POINT CONCENTRATIONS
GROUNDWATER EXCLUDING HOT SPOTS

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Groundwater EPC [3]
	Site Data/Concentration [2]						
Metals (mg/L)							
Aluminum	0.1	0.1	1 / 5	33	33	6.64	33
Arsenic	0.005	0.005	2 / 5	0.01	0.084	0.0203	0.084
Barium	0	0	5 / 5	0.006	0.28	0.0714	0.28
Calcium	0	0	4 / 4	5.1	22	14.025	22
Chromium	0.01	0.03	1 / 24	0.15	0.15	0.0119	0.15
Cobalt	0	0	1 / 1	0.089	0.089	0.089	0.089
Copper	0.025	0.025	2 / 3	0.027	0.23	0.0898	0.23
Iron	0.054	0.054	4 / 5	0.04	69	14.9734	69
Lead	0.005	0.005	2 / 5	0.006	0.051	0.0129	0.051
Magnesium	0	0	4 / 4	0.92	10	4.4175	10
Manganese	0	0	5 / 5	0.015	2	0.735	2
Nickel	0	0	1 / 1	0.13	0.13	0.13	0.13
Potassium	0	0	3 / 3	0.74	8.1	3.9133	8.1
Sodium	0	0	6 / 6	12	78	50.55	78
Vanadium	0	0	1 / 1	0.15	0.15	0.15	0.15
Zinc	0	0	3 / 3	0.028	22	7.3543	22
Inorganics (mg/L)							
Chloride	2	3	41 / 43	3.6	1100	155.0209	1100
Nitrate as N	0.05	0.2	1 / 4	2.1	2.1	0.5625	2.1
Nitrite as N	0.05	0.05	1 / 3	0.05	0.05	0.0333	0.05
Nitrogen, Ammonia	0.04	0.1	40 / 45	0.12	630	28.1046	630
Sulfate as SO4	10	10	43 / 44	4.4	3370	305.3773	3370

Notes:

1 Selection of OHM of Concern for this medium is presented in Table 4.

2 Samples included in Site Data set are presented in Attachment 1.

Duplicate samples were averaged with their original samples prior to calculation of summary statistics.

The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value

TABLE 42
ZONE II GROUNDWATER EXPOSURE POINT CONCENTRATIONS
GROUNDWATER EXCLUDING HOT SPOTS

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						Groundwater EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	

for non-detects.

3 The EPC is the maximum detected concentration.

EPC = Exposure Point Concentration

OHM = Oil or Hazardous Material

SQL = Sample Quantitation Limit

MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 43
GROUNDWATER EXPOSURE POINT CONCENTRATIONS
ALTRON WELLS PROCESS WATER (GROUNDWATER)
CURRENT LAND USE

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Frequency of Detection	Minimum	Maximum	Groundwater EPC [3]	Building Air EPC [4] (ug/m³)
VOCs (mg/L)					
2,4,4-Trimethyl-1-pentene	1 / 2	0.004	0.004	0.004	0.46
2,4,4-Trimethyl-2-Pentene	1 / 2	0.001	0.001	0.001	0.11
Acetone	1 / 2	0.007	0.007	0.007	0.81
SVOCS (mg/L)					
bis(2-EthylHexyl)phthalate	1 / 2	0.005	0.005	0.005	NA
Diethylphthalate	1 / 2	0.001	0.001	0.001	NA
Metals (mg/L)					
Aluminum	4 / 4	0.036	0.22	0.22	NA
Barium	4 / 4	0.04	0.051	0.051	NA
Calcium	4 / 4	17	20	20	NA
Copper	3 / 4	0.01	0.07	0.07	NA
Iron	4 / 4	0.011	0.84	0.84	NA
Lead	1 / 4	0.01	0.01	0.01	NA
Magnesium	4 / 4	3.7	4.4	4.4	NA
Manganese	4 / 4	0.95	3.64	3.64	NA
Potassium	4 / 4	2.55	5	5	NA
Sodium	4 / 4	65	85.4	85.4	NA
Zinc	2 / 4	0.032	0.037	0.037	NA
Inorganics (mg/L)					
Chloride	2 / 2	156	180	180	NA
Nitrogen, Ammonia	2 / 2	9	60.7	60.7	330
Sulfate as SO4	2 / 2	86.8	316	316	NA

Notes:

1 All OHM potentially related to the site were included as OHM of concern.

2 Samples included in the data set include the following:
For VOCs, samples collected from wells B1 and B3 17-Oct-96.
For SVOCs, samples collected from wells B1 and B3 15-July-93 (no SVOC analyses were conducted on the samples collected in 1996).
For metals, samples collected from wells B1 and B3 10-Mar-92 and 15-July-93 (no metals analyses were conducted on the samples collected in 1996).
For inorganics, samples collected from wells B1 and B3 17-Oct-96.

3 The EPC is the maximum detected concentration.

4 The building air EPC is calculated in Attachment 5.

EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
NA = Not Applicable; OHM is not a OHM of concern via this exposure pathway.

TABLE 44
ZONE II GROUNDWATER
EXPOSURE POINT CONCENTRATIONS
TOWN WELLS - CURRENT CONDITIONS
UNTREATED WATER

Olin Corporation

Wilmington, MA Facility

OHM[1]	Groundwater EPC[2]
CHESTNUT STREET	
VOCs (mg/L)	
cis-1,2-Dichloroethene	0.00035
Chloroform	0.000953
Methylene Chloride	0.0016
Trichloroethene (TCE)	0.0034
SVOCs (mg/L)	
1,3-dichlorobenzene	0.001
Naphthalene	0.00049
bis(2-ethylhexyl)phthalate	0.0066
Metals (mg/L)	
Barium	0.02
Calcium	18.75
Iron	1.35
Lead	0.0022
Magnesium	4.32
Manganese	0.51
Potassium	3
Sodium	41.5
Zinc	0.035
Inorganics (mg/L)	
Chloride	83.96
Nitrate as N	0.29
Nitrogen, Ammonia	1.36
Sulfate as SO4	48.9
BUTTERS ROW 1	
VOCs (mg/L)	
1,2-Dichloroethane	0.00015
Benzene	0.00011
Chlorobenzene	0.00024
cis-1,2-Dichloroethene	0.033
trans-1,2-Dichloroethene	0.00028
Methylene Chloride	0.0011
Trichloroethene (TCE)	0.0015
Vinyl Chloride	0.00024
SVOCs (mg/L)	
Naphthalene	0.0011
Metals (mg/L)	
Arsenic	0.01
Barium	0.026

TABLE 44
ZONE II GROUNDWATER
EXPOSURE POINT CONCENTRATIONS
TOWN WELLS - CURRENT CONDITIONS
UNTREATED WATER

Olin Corporation

Wilmington, MA Facility

OHM[1]	Groundwater EPC[2]
Calcium	41.25
Copper	0.09675
Iron	3.9
Magnesium	8.87
Manganese	0.73
Potassium	6.2
Sodium	71.15
Zinc	0.028
Inorganics (mg/L)	
Chloride	107.59
Nitrate as N	0.17
Nitrite as N	0.02
Nitrogen, Ammonia	6.44
Sulfate as SO4	137.88
BUTTERS ROW 2	
VOCs (mg/L)	
1,2-Dichloroethane	0.00013
cis-1,2-Dichloroethene	0.012
Methylene Chloride	0.0017
Trichloroethene (TCE)	0.00022
Vinyl Chloride	0.00037
SVOCs (mg/L)	
Naphthalene	0.00046
Metals (mg/L)	
Barium	0.023
Calcium	23.25
Iron	7.9
Magnesium	4.5
Manganese	0.27
Potassium	3.4
Sodium	24
Inorganics (mg/L)	
Chloride	65.37
Nitrate as N	0.276
Nitrogen, Ammonia	0.475
Sulfate as SO4	39.7

Notes:

[1] OHM are those detected in the samples collected in the most recent four quarters of groundwater sampling.

TABLE 44
ZONE II GROUNDWATER
EXPOSURE POINT CONCENTRATIONS
TOWN WELLS - CURRENT CONDITIONS
UNTREATED WATER

Olin Corporation

Wilmington, MA Facility

OHM[1]	Groundwater EPC[2]

[2] The EPC is the average detected concentration of samples collected in the most recent four quarters of groundwater sampling.
Measured concentrations are based on samples taken from raw water at each of these wells. Concentrations of these OHM are not necessarily site-related.
EPCs were identified, but risks were not calculated because no one is exposed to the untreated water.

EPC = Exposure Point Concentration

OHM = Oil or Hazardous Material

TABLE 45
ZONE II GROUNDWATER
EXPOSURE POINT CONCENTRATIONS
TOWN WELLS - CURRENT CONDITIONS
TREATED WATER

Olin Corporation

Wilmington, MA Facility

OHM[1]	Groundwater EPC[2]
Metals (mg/L)	
Manganese	0.0336
Inorganics (mg/L)	
Chloride	78.4
Nitrogen, Ammonia	ND[3]
Sulfate as SO4	79.5

Notes:

1 OHM are those detected in the finished water from the Butters Row Treatment Plant.

2 The EPC is the detected concentration of the OHM in the finished water at the Butters Row Treatment Plant.

3 Although the analysis reported ammonia concentrations, the analytical method used measured chloramines, not ammonia.

EPC = Exposure Point Concentration

OHM = Oil or Hazardous Material

TABLE 46
ZONE II GROUNDWATER EXPOSURE POINT CONCENTRATIONS
TOWN WELLS - FUTURE CONDITIONS
SCENARIO: ALL WELLS PUMPING - WET SEASON
Olin Corporation
Wilmington, MA Facility

SCENARIO *WITH* WELL GW-83-D												
Well	**Flow Conditions**		**OHM / Groundwater EPC (mg/L)** [1]									
Well	5-year *average flow* (gpm)	*Relative* Flow	Chloride	Ammonia	Sodium	Sulfate	Aluminum	Iron	Calcium	Magnesium	Manganese	Total *Dissolved* Solids
Butter's Row #1	190.2	0.2	114	9.7	77	192	0.32	14.7	37	10	1.11	465
Butters Row #2	286.7	0.3	66	0.38	33	43	0.2	5.5	21	4.9	0.25	316
Chestnut Street #1	173.3	0.18	284	65	309	849	1.4	57	40	22	3	1584
Chestnut #2/1A	263.1	0.28	57	0.63	33	30	0.2	1.1	15	4.8	0.02	208
Town Park	30.2	0.03	94	0.42	39	30	0.2	0.99	17	4.5	0.47	233
TOTAL	943.5											
	1.35864 mgd											
Incoming OHM at BRTP (est; mg/L) [2]			112.5	13.94	91.3	213.4	0.438	15.2	25.6	8.9	0.86	538
OHM in finished water (est; mg/L) [2]			112.5	NP [3]	91.3	234.4	NE	<0.1	NE	NE	0.034	NE

TABLE 46
ZONE II GROUNDWATER EXPOSURE POINT CONCENTRATIONS
TOWN WELLS - FUTURE CONDITIONS
SCENARIO: ALL WELLS PUMPING - WET SEASON
Olin Corporation
Wilmington, MA Facility

SCENARIO *WITHOUT* WELL GW-83-D												
Well	**Flow Conditions**		**OHM / Groundwater EPC (mg/L)** [1]									
Well	5-year average flow (gpm)	Relative Flow	Chloride	Ammonia	Sodium	Sulfate	Aluminum	Iron	Calcium	Magnesium	Manganese	Total Dissolved Solids
Butter's Row #1	190.2	0.2	93	3.3	49	112	0.19	9.1	35	8.3	0.9	328
Butters Row #2	286.7	0.3	66	0.38	33	43	0.2	5.5	21	4.9	0.25	316
Chestnut Street #1	173.3	0.18	81	4.3	41	87	0.19	5	27	6	1	288
Chestnut #2/1A	263.1	0.28	57	0.63	33	30	0.2	1.1	15	4.8	0.02	208
Town Park	30.2	0.03	94	0.42	39	30	0.2	0.99	17	4.5	0.47	233
TOTAL	943.5											
	1.35864 mgd											
Incoming OHM at BRTP (est; mg/L) [2]			71.8	1.74	37.5	60.3	0.19	4.7	22.9	5.7	0.45	277
OHM in finished water (est; mg/L) [2]			71.8	NP [3]	37.5	81.3	NE	<0.1	NE	NE	0.034	NE

Notes:

[1] OHM are those that were modeled, as described in text.

[2] *Concentrations calculated as described in text.*

All data represent dissolved concentrations except manganese, for which the data presented represent total concentrations.

3 No ammonia as ammonium ion would be expected in water containing greater than 0.1 mg/L free residual chlorine. The presence of free residual chlorine indicates that any ammonia has been oxidized. At Butter's Row, maintenance of free residual chlorine is required for disinfection purposes.

EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
gpm = gallon per minute
mgd = million gallons per day
BRTP = Butters Row Treatment Plant
NE = Not Evaluated
NP = Not Present

TABLE 47
ZONE II GROUNDWATER EXPOSURE POINT CONCENTRATIONS
TOWN WELLS - FUTURE CONDITIONS
SCENARIO: ALL WELLS PUMPING - DRY SEASON
Olin Corporation
Wilmington, MA Facility

Well	Flow Conditions		OHM / Groundwater EPC (mg/L) [1]									
Well	5-year average flow (gpm)	Relative Flow	Chloride	Ammonia	Sodium	Sulfate	Aluminum	Iron	Calcium	Magnesium	Manganese	Total Dissolved Solids
Butter's Row #1	190.2	0.2	89	2.6	45	95	0.19	9.1	33	7.5	0.84	303
Butters Row #2	286.7	0.3	66	0.38	33	43	0.2	5.5	21	4.9	0.25	316
Chestnut Street #1	173.3	0.18	134	15	67	262	0.2	6.4	15	13	2.1	588
Chestnut #2/1A	263.1	0.28	57	0.63	33	30	0.2	1.1	15	4.8	0.02	208
Town Park	30.2	0.03	94	0.42	39	30	0.2	0.99	17	4.5	0.47	233
TOTAL	943.5											
	1.35864 mgd											
Incoming OHM at BRTP (est; mg/L) [2]			80.5	3.52	41.4	88.4	0.196	5.0	20.3	6.8	0.64	326
OHM in finished water (est; mg/L) [2]			80.5	NP [3]	41.4	109.4	NE	<0.1	NE	NE	0.034	NE

Notes:

[1] OHM are those that were modeled, as described in text.

[2] Concentrations calculated as described in text.

All data represent dissolved concentrations except manganese, for which the data presented represent total concentrations.

3 No ammonia as ammonium ion would be expected in water containing greater than 0.1 mg/L free residual chlorine. The presence of free residual chlorine indicates that any ammonia has been oxidized. At Butter's Row, maintenance of free residual chlorine is required for disinfection purposes.

EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
gpm = gallon per minute
mgd = million gallons per day
BRTP = Butters Row Treatment Plant
NE = Not Evaluated
NP = Not Present

TABLE 48
ZONE II GROUNDWATER EXPOSURE POINT CONCENTRATIONS
TOWN WELLS - FUTURE CONDITIONS
SCENARIO: BUTTERS ROW #1 PUMPING - WET SEASON
Olin Corporation
Wilmington, MA Facility

Well	Flow Conditions		OHM / Groundwater EPC (mg/L) [1]									
Well	5-year average flow (gpm)	Relative Flow	Chloride	Ammonia	Sodium	Sulfate	Aluminum	Iron	Calcium	Magnesium	Manganese	Total Dissolved Solids
Butter's Row #1	190.2	1	90	2.5	46	92	0.19	7	32	7.4	0.79	309
Butters Row #2	286.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chestnut Street #1	173.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chestnut #2/1A	263.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Town Park	30.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	943.5											
	1.35864 mgd											
Incoming OHM at BRTP (est; mg/L) [2]			90.0	2.50	46.0	92.0	0.190	7.0	32.0	7.4	0.79	309.0
OHM in finished water (est; mg/L) [2]			90.0	NP [3]	46.0	113.0	NE	<0.1	NE	NE	0.034	NE

Notes:

[1] OHM are those that were modeled, as described in text.

[2] Concentrations calculated as described in text.

All data represent dissolved concentrations except manganese, for which the data presented represent total concentrations.

3 No ammonia as ammonium ion would be expected in water containing greater than 0.1 mg/L free residual chlorine. The presence of free residual chlorine indicates that any ammonia has been oxidized. At Butter's Row, maintenance of free residual chlorine is required for disinfection purposes.

EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
gpm = gallon per minute
mgd = million gallons per day
BRTP = Butters Row Treatment Plant
NA = Not Applicable
NE = Not Evaluated
NP = Not Present

TABLE 49
ZONE II GROUNDWATER EXPOSURE POINT CONCENTRATIONS
TOWN WELLS - FUTURE CONDITIONS
SCENARIO: BUTTERS ROW #1 PUMPING - DRY SEASON
Olin Corporation
Wilmington, MA Facility

Well	Flow Conditions		OHM / Groundwater EPC (mg/L) [1]									
Well	5-year average flow (gpm)	Relative Flow	Chloride	Ammonia	Sodium	Sulfate	Aluminum	Iron	Calcium	Magnesium	Manganese	Total Dissolved Solids
Butter's Row #1	190.2	1	79	1.5	40	61	0.2	6.1	25	5.9	0.55	268
Butters Row #2	286.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chestnut Street #1	173.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chestnut #2/1A	263.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Town Park	30.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	943.5											
	1.35864 mgd											
Incoming OHM at BRTP (est; mg/L) [2]			79.0	1.50	40.0	61.0	0.200	6.1	25.0	5.9	0.55	268.0
OHM in finished water (est; mg/L) [2]			79.0	NP [3]	40.0	82.0	NE	<0.1	NE	NE	0.034	NE

Notes:

[1] OHM are those that were modeled, as described in text.

[2] Concentrations calculated as described in text.

All data represent dissolved concentrations except manganese, for which the data presented represent total concentrations.

3 No ammonia as ammonium ion would be expected in water containing greater than 0.1 mg/L free residual chlorine. The presence of free residual chlorine indicates that any ammonia has been oxidized. At Butter's Row, maintenance of free residual chlorine is required for disinfection purposes.

EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
gpm = gallon per minute
mgd = million gallons per day
BRTP = Butters Row Treatment Plant
NA = Not Applicable
NE = Not Evaluated
NP = Not Present

TABLE 50
SURFACE WATER EXPOSURE POINT CONCENTRATIONS - EAST DITCH
CURRENT LAND USE (HISTORICAL DATA)

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
VOCs (mg/L)							
1,1,1-Trichloroethane	0.005 :	0.005	5 / 12	0.001	0.006	0.0027	0.0027
1,2-Dichloroethene(total)	0.005 :	0.005	6 / 17	0.001	0.01	0.0036	0.0036
2,4,4-Trimethyl-1-pentene	0.01 :	0.01	9 / 12	0.003	0.023	0.007	0.007
2,4,4-Trimethyl-2-Pentene	0.01 :	0.01	6 / 12	0.001	0.006	0.0038	0.0038
4-Methyl-2-Pentanone (MIBK)	0.015 :	0.015	3 / 12	0.001	0.002	0.006	0.002
Chloroethane	0.01 :	0.01	5 / 12	0.001	0.014	0.0048	0.0048
Ethylbenzene	0.005 :	0.005	3 / 12	0.001	0.003	0.0023	0.0023
Methylene Chloride	0.01 :	0.01	7 / 12	0.001	0.003	0.0032	0.003
Toluene	0.005 :	0.005	9 / 12	0.005	0.076	0.0263	0.0263
Trichloroethene (TCE)	0.005 :	0.005	8 / 12	0.001	0.013	0.005	0.005
Vinyl Chloride	0.01 :	0.01	3 / 12	0.002	0.002	0.0043	0.002
Xylenes, Total	0.005 :	0.006	3 / 12	0.005	0.007	0.0034	0.0034
SVOCs (mg/L)							
Di-n-octylphthalate	0.01 :	0.01	1 / 12	0.0085	0.0085	0.0053	0.0053
N-Nitrosodiphenylamine	0.01 :	0.01	2 / 12	0.002	0.0025	0.0045	0.0025
Phenol	0.01 :	0.01	1 / 12	0.001	0.001	0.0047	0.001
bis(2-EthylHexyl)phthalate	0 :	0	12 / 12	0.002	0.074	0.0122	0.0122
Metals (mg/L)							
Aluminum	0.1 :	0.1	9 / 12	0.29	3.5	1.4342	1.4342
Arsenic	0.005 :	0.005	4 / 12	0.006	0.037	0.0088	0.0088
Barium	0 :	0	11 / 11	0.02	0.039	0.0239	0.0239
Calcium	0 :	0	12 / 12	26	35	29.5833	29.5833
Chromium	0.015 :	0.015	8 / 12	0.022	0.41	0.1598	0.1598
Hexavalent Chromium	0.015 :	0.015	2 / 7	0.024	0.0305	0.0131	0.0131
Iron	0 :	0	12 / 12	0.49	5.4	2.23	2.23
Lead	0.005 :	0.005	3 / 12	0.006	0.03	0.007	0.007

TABLE 50
SURFACE WATER EXPOSURE POINT CONCENTRATIONS - EAST DITCH
CURRENT LAND USE (HISTORICAL DATA)

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]
Magnesium	0	0	12 / 12	3.6	7.3	5.0833	5.0833
Manganese	0	0	12 / 12	0.28	1.25	0.6908	0.6908
Potassium	0	0	12 / 12	2.5	6.6	3.575	3.575
Sodium	0	0	12 / 12	30	160	64.75	64.75
Zinc	0	0	12 / 12	0.037	0.2	0.0777	0.0777
Inorganics (mg/L)							
Chloride	0	0	12 / 12	44	210	86	86
Nitrate as N	0	0	2 / 2	2.3	5.85	4.075	4.075
Nitrite as N	0.05	0.05	1 / 7	0.331	0.331	0.0687	0.0687
Nitrogen, Ammonia	0	0	12 / 12	0.34	59	16.455	16.455
Sulfate as SO4	0	0	12 / 12	26	400	120.1667	120.167

Notes:

1 Selection of OHM of Concern for this medium is presented in Table 5.

2 Samples included in Site Data set are presented in Attachment 1.

Duplicate samples were averaged with their original samples prior to calculation of summary statistics.

The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.

The median represents the median value of all sample results, including non-detects, with the SQL used as the value for non-detects.

3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.

EPC = Exposure Point Concentration

OHM = Oil or Hazardous Material

SQL = Sample Quantitation Limit

MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 51
SURFACE WATER EXPOSURE POINT CONCENTRATIONS - ON-SITE DITCH
CURRENT LAND USE (HISTORICAL DATA)

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
VOCs (mg/L)							
2,4,4-Trimethyl-1-pentene	0.01 :	0.01	5 / 12	0.005	0.028	0.0082	0.0082
2,4,4-Trimethyl-2-Pentene	0.01 :	0.01	5 / 12	0.002	0.01	0.0048	0.0048
Bromoform	0.005 :	0.005	3 / 12	0.001	0.003	0.0023	0.0023
SVOCs (mg/L)							
Di-n-octylphthalate	0.01 :	0.01	2 / 12	0.001	0.006	0.0048	0.0048
N-Nitrosodiphenylamine	0.01 :	0.01	5 / 12	0.002	0.003	0.0038	0.003
Phenol	0.01 :	0.01	2 / 12	0.001	0.002	0.0044	0.002
bis(2-EthylHexyl)phthalate	0.01 :	0.17	6 / 12	0.002	0.009	0.0161	0.009
Metals (mg/L)							
Aluminum	0 :	0	12 / 12	0.17	21	5.615	5.615
Arsenic	0.005 :	0.005	3 / 12	0.005	0.25	0.0241	0.0241
Barium	0 :	0	12 / 12	0.007	0.055	0.0236	0.0236
Calcium	0 :	0	12 / 12	4	140	39.075	39.075
Chromium	0.015 :	0.015	8 / 12	0.057	1.7	0.4062	0.4062
Cobalt	0.015 :	0.015	3 / 12	0.02	0.046	0.0132	0.0132
Hexavalent Chromium	0.015 :	0.015	1 / 2	0.074	0.074	0.0408	0.0408
Iron	0 :	0	12 / 12	0.2	72	7.89	7.89
Lead	0.005 :	0.005	1 / 12	0.18	0.18	0.0173	0.0173
Magnesium	0 :	0	12 / 12	1.8	12	4.75	4.75
Manganese	0 :	0	12 / 12	0.013	2.3	0.7925	0.7925
Mercury	0.0002 :	0.0002	1 / 12	0.0009	0.0009	0.0002	0.0002
Nickel	0.04 :	0.04	1 / 12	0.049	0.049	0.0224	0.0224
Potassium	0 :	0	12 / 12	0.45	2.8	2.0558	2.0558
Sodium	0 :	0	12 / 12	7	260	122.75	122.75
Vanadium	0.025 :	0.025	1 / 12	0.19	0.19	0.0273	0.0273
Zinc	0.025 :	0.025	11 / 12	0.026	0.11	0.0611	0.0611

TABLE 51
SURFACE WATER EXPOSURE POINT CONCENTRATIONS - ON-SITE DITCH
CURRENT LAND USE (HISTORICAL DATA)

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
Inorganics (mg/L)							
Chloride	0 :	0	12 / 12	13	260	128.5833	128.583
Nitrate as N	0 :	0	2 / 2	6.4	6.6	6.5	6.5
Nitrite as N	0 :	0	2 / 2	0.054	0.085	0.0695	0.0695
Nitrogen, Ammonia	0.1 :	0.1	10 / 12	0.26	85	28.4458	28.4458
Sulfate as SO4	0 :	0	12 / 12	76	600	304.5	304.5

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 5.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
The median represents the median value of all sample results, including non-detects, with the SQL used as the value for non-detects.
3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 52
SURFACE WATER EXPOSURE POINT CONCENTRATIONS - WEST DITCH OFF-SITE
CURRENT LAND USE (HISTORICAL DATA)

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]
VOCs (mg/L)							
2,4,4-Trimethyl-1-pentene	0.01 :	0.01	2 / 4	0.006	0.2	0.0539	0.0539
2,4,4-Trimethyl-2-Pentene	0.01 :	0.01	2 / 4	0.002	0.081	0.0236	0.0236
Acetone	0.015 :	0.015	1 / 4	0.093	0.093	0.0182	0.0182
Bromoform	0.005 :	0.005	2 / 4	0.001	0.0025	0.0021	0.0021
SVOCs (mg/L)							
Di-n-octylphthalate	0.01 :	0.01	1 / 4	0.001	0.001	0.004	0.001
N-Nitrosodiphenylamine	0.01 :	0.01	2 / 4	0.0035	0.031	0.0111	0.0111
Phenol	0.01 :	0.01	3 / 4	0.002	0.003	0.0034	0.003
bis(2-EthylHexyl)phthalate	0.01 :	0.025	1 / 4	0.006	0.006	0.0071	0.006
Metals (mg/L)							
Aluminum	0.1 :	0.1	3 / 4	0.32	34	11.73	11.73
Barium	0 :	0	4 / 4	0.018	0.04	0.027	0.027
Calcium	0 :	0	4 / 4	15	37	27	27
Chromium	0.015 :	0.015	3 / 4	0.032	9.9	3.0224	3.0224
Cobalt	0.015 :	0.015	2 / 4	0.016	0.11	0.0342	0.0342
Copper	0.025 :	0.025	1 / 4	0.12	0.12	0.0394	0.0394
Hexavalent Chromium	0 :	0	1 / 1	0.2	0.2	0.2	0.2
Iron	0 :	0	4 / 4	0.048	28	8.4945	8.4945
Lead	0.005 :	0.005	1 / 4	0.015	0.015	0.0056	0.0056
Magnesium	0 :	0	4 / 4	2	17	7.65	7.65
Manganese	0 :	0	4 / 4	0.16	4.4	1.545	1.545
Nickel	0.04 :	0.04	1 / 4	0.11	0.11	0.0425	0.0425
Potassium	0 :	0	4 / 4	1.2	3.7	2.075	2.075
Sodium	0 :	0	4 / 4	25	210	118.75	118.75
Zinc	0.025 :	0.025	2 / 4	0.0905	0.19	0.0764	0.0764

TABLE 52
SURFACE WATER EXPOSURE POINT CONCENTRATIONS - WEST DITCH OFF-SITE
CURRENT LAND USE (HISTORICAL DATA)

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
Inorganics (mg/L)							
Chloride	0	: 0	4 / 4	32	200	114.75	114.75
Nitrate as N	0	: 0	2 / 2	0.2	1.2	0.7	0.7
Nitrogen, Ammonia	0	: 0	4 / 4	3.9	110	57.35	57.35
Sulfate as SO4	0	: 0	4 / 4	78	830	383.25	383.25

Notes:

1 Selection of OHM of Concern for this medium is presented in Table 5.

2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
The median represents the median value of all sample results, including non-detects, with the SQL used as the value for non-detects.

3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.

EPC = Exposure Point Concentration
OHM = *Oil or Hazardous Material*
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 53
SURFACE WATER EXPOSURE POINT CONCENTRATIONS - EAST DITCH
CURRENT LAND USE (RECENT DATA)

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
Metals (mg/L)							
Aluminum	0	0	1 / 1	1.6	1.6	1.6	1.6
Barium	0	0	1 / 1	0.019	0.019	0.019	0.019
Calcium	0	0	1 / 1	56	56	56	56
Chromium	0	0	1 / 1	0.023	0.023	0.023	0.023
Iron	0	0	1 / 1	0.54	0.54	0.54	0.54
Magnesium	0	0	1 / 1	4.7	4.7	4.7	4.7
Manganese	0	0	1 / 1	0.26	0.26	0.26	0.26
Potassium	0	0	1 / 1	1.9	1.9	1.9	1.9
Sodium	0	0	1 / 1	120	120	120	120
Inorganics (mg/L)							
Chloride	0	0	1 / 1	120	120	120	120
Nitrate as N	0	0	1 / 1	2.7	2.7	2.7	2.7
Nitrogen, Ammonia	0	0	1 / 1	28	28	28	28
Sulfate as SO4	0	0	1 / 1	280	280	280	280
Sulfide	0	0	1 / 1	2	2	2	2

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 6.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
The median represents the median value of all sample results, including non-detects, with the SQL used as the value for non-detects.
3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.
EPC = Exposure Point Concentration

TABLE 53
SURFACE WATER EXPOSURE POINT CONCENTRATIONS - EAST DITCH
CURRENT LAND USE (RECENT DATA)

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	

OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 54
SURFACE WATER EXPOSURE POINT CONCENTRATIONS - ON-SITE DITCH
CURRENT LAND USE (RECENT DATA)

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]
	Site Data/Concentration [2]						
Metals (mg/L)							
Aluminum	0 :	0	4 / 4	0.13	2.4	1.045	1.045
Barium	0 :	0	4 / 4	0.019	0.038	0.0273	0.0273
Calcium	0 :	0	4 / 4	43	280	154.375	154.375
Chromium	0.015 :	0.015	2 / 4	0.0195	0.02	0.0136	0.0136
Iron	0.53 :	0.53	3 / 4	0.082	3.65	1.1868	1.1868
Magnesium	0 :	0	4 / 4	2.5	6.3	4.45	4.45
Manganese	0 :	0	4 / 4	0.23	0.775	0.5063	0.5063
Potassium	0 :	0	4 / 4	1.1	3.9	2.625	2.625
Sodium	0 :	0	4 / 4	16	130	70.5	70.5
Inorganics (mg/L)							
Chloride	0 :	0	4 / 4	24	160	76	76
Nitrate & Nitrite as N	0 :	0	1 / 1	6.8	6.8	6.8	6.8
Nitrate as N	0 :	0	3 / 3	0.25	7.2	3.8833	3.8833
Nitrogen, Ammonia	0 :	0	3 / 3	2	91	51.6667	51.6667
Sulfate as SO4	0 :	0	4 / 4	130	1100	597.5	597.5
Sulfide	1 :	1	1 / 3	5	5	1.25	1.25

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 6.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
The median represents the median value of all sample results, including non-detects, with the SQL used as the value for non-detects.
3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.

TABLE 54
SURFACE WATER EXPOSURE POINT CONCENTRATIONS - ON-SITE DITCH
CURRENT LAND USE (RECENT DATA)

Olin Corporation
Wilmington, MA Facility

	Site Data/Concentration [2]						
OHM of Concern [1]	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]

EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 55
SURFACE WATER EXPOSURE POINT CONCENTRATIONS - WEST DITCH OFF-SITE
CURRENT LAND USE (RECENT DATA)

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
Metals (mg/L)							
Aluminum	0.1 :	0.1	2 / 3	0.11	0.31	0.1567	0.1567
Arsenic	0.005 :	0.005	1 / 3	0.01	0.01	0.005	0.005
Barium	0 :	0	3 / 3	0.01	0.02	0.015	0.015
Calcium	0 :	0	3 / 3	7.3	15	11.1	11.1
Iron	0.37 :	0.37	2 / 3	1.5	5.6	2.4283	2.4283
Magnesium	0 :	0	3 / 3	0.91	2.7	1.6033	1.6033
Manganese	0 :	0	3 / 3	0.014	0.49	0.2007	0.2007
Potassium	3 :	3	2 / 3	1.3	4.8	2.5333	2.5333
Sodium	0 :	0	3 / 3	25	66	49.3333	49.3333
Inorganics (mg/L)							
Chloride	0 :	0	3 / 3	35	82	63	63
Nitrate as N	0.05 :	0.05	2 / 3	0.55	0.7	0.425	0.425
Nitrite as N	0.05	0.5	0	0	0	0.125	0
Nitrogen, Ammonia	0.05 :	0.05	2 / 3	0.1	6.8	2.3083	2.3083
Sulfate as SO4	0 :	0	3 / 3	25	55	36.3333	36.3333
Sulfide	1 :	1	1 / 3	2	2	1	1

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 6.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
The median represents the median value of all sample results, including non-detects, with the SQL used as the value for non-detects.
3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.

TABLE 55
SURFACE WATER EXPOSURE POINT CONCENTRATIONS - WEST DITCH OFF-SITE
CURRENT LAND USE (RECENT DATA)

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	

EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 56
SURFACE WATER EXPOSURE POINT CONCENTRATIONS - HOT SPOT
FUTURE LAND USE (HISTORICAL DATA)

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
VOCs (mg/L)							
1,1,1-Trichloroethane	0.005 :	0.005	2 / 20	0.001	0.001	0.0024	0.001
1,2-Dichloroethene(total)	0.005 :	0.005	6 / 25	0.001	0.01	0.0033	0.0033
2,4,4-Trimethyl-1-pentene	0.01 :	0.01	14 / 20	0.003	0.2	0.0164	0.0164
2,4,4-Trimethyl-2-Pentene	0.01 :	0.01	11 / 20	0.001	0.081	0.0078	0.0078
4-Methyl-2-Pentanone (MIBK)	0.015 :	0.015	3 / 20	0.001	0.002	0.0066	0.002
Acetone	0.015 :	0.015	1 / 20	0.093	0.093	0.0096	0.0096
Bromoform	0.005 :	0.005	5 / 20	0.001	0.003	0.0023	0.0023
Chloroethane	0.01 :	0.01	3 / 20	0.001	0.002	0.0045	0.002
Ethylbenzene	0.005 :	0.005	1 / 20	0.001	0.001	0.0024	0.001
Methylene Chloride	0.01 :	0.01	6 / 20	0.001	0.003	0.004	0.003
Toluene	0.005 :	0.005	6 / 20	0.005	0.076	0.0155	0.0155
Trichloroethene (TCE)	0.005 :	0.005	6 / 20	0.003	0.013	0.0042	0.0042
Vinyl Chloride	0.01 :	0.01	3 / 20	0.002	0.002	0.0046	0.002
Xylenes, Total	0.005 :	0.006	2 / 20	0.005	0.006	0.0028	0.0028
SVOCs (mg/L)							
Di-n-octylphthalate	0.01 :	0.01	3 / 20	0.001	0.0085	0.0048	0.0048
N-Nitrosodiphenylamine	0.01 :	0.01	9 / 20	0.002	0.031	0.0053	0.0053
Phenol	0.01 :	0.01	5 / 20	0.001	0.003	0.0043	0.003
bis(2-EthylHexyl)phthalate	0.01 :	0.17	14 / 20	0.002	0.074	0.0165	0.0165
Metals (mg/L)							
Aluminum	0.1 :	0.1	19 / 20	0.21	34	4.7145	4.7145
Arsenic	0.005 :	0.005	4 / 20	0.005	0.037	0.0063	0.0063
Barium	0 :	0	20 / 20	0.009	0.04	0.0226	0.0226
Calcium	0 :	0	20 / 20	6.9	80	30.445	30.445
Chromium	0.015 :	0.015	17 / 20	0.022	9.9	0.9314	0.9314
Cobalt	0.015 :	0.015	4 / 20	0.016	0.11	0.0156	0.0156

TABLE 56
SURFACE WATER EXPOSURE POINT CONCENTRATIONS - HOT SPOT
FUTURE LAND USE (HISTORICAL DATA)

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
Copper	0.025 :	0.025	1 / 20	0.12	0.12	0.0179	0.0179
Hexavalent Chromium	0.015 :	0.015	4 / 10	0.024	0.2	0.0374	0.0374
Iron	0 :	0	20 / 20	0.048	28	3.6234	3.6234
Lead	0.005 :	0.005	4 / 20	0.006	0.03	0.0059	0.0059
Magnesium	0 :	0	20 / 20	1.9	17	6.2	6.2
Manganese	0 :	0	20 / 20	0.013	4.4	1.0112	1.0112
Nickel	0.04 :	0.04	2 / 20	0.049	0.11	0.026	0.026
Potassium	0 :	0	20 / 20	1.2	6.6	2.98	2.98
Sodium	0 :	0	20 / 20	25	210	114.75	114.75
Zinc	0.025 :	0.025	18 / 20	0.026	0.2	0.0765	0.0765
Inorganics (mg/L)							
Chloride	0 :	0	20 / 20	32	210	127.45	127.45
Nitrate as N	0 :	0	6 / 6	0.2	6.6	3.7583	3.7583
Nitrite as N	0.05 :	0.05	3 / 11	0.054	0.331	0.0609	0.0609
Nitrogen, Ammonia	0 :	0	20 / 20	0.26	110	37.023	37.023
Sulfate as SO4	0 :	0	20 / 20	27	830	271.35	271.35

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 5.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
The median represents the median value of all sample results, including non-detects, with the SQL used as the value for non-detects.
3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.
EPC = Exposure Point Concentration

TABLE 56
SURFACE WATER EXPOSURE POINT CONCENTRATIONS - HOT SPOT
FUTURE LAND USE (HISTORICAL DATA)

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	

OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 57
SURFACE WATER EXPOSURE POINT CONCENTRATIONS - NON-HOT SPOT
FUTURE LAND USE (HISTORICAL DATA)

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]
VOCs (mg/L)							
1,1,1-Trichloroethane	0.005 :	0.005	3 / 8	0.003	0.006	0.0032	0.0032
2,4,4-Trimethyl-1-pentene	0.01 :	0.01	2 / 8	0.017	0.023	0.0088	0.0088
2,4,4-Trimethyl-2-Pentene	0.01 :	0.01	2 / 8	0.005	0.006	0.0051	0.0051
Chloroethane	0.01 :	0.01	2 / 8	0.005	0.014	0.0061	0.0061
Ethylbenzene	0.005 :	0.005	2 / 8	0.001	0.003	0.0024	0.0024
Methylene Chloride	0.01 :	0.01	1 / 8	0.003	0.003	0.0048	0.003
Toluene	0.005 :	0.005	3 / 8	0.005	0.019	0.0057	0.0057
Trichloroethene (TCE)	0.005 :	0.005	2 / 8	0.001	0.001	0.0021	0.001
Xylenes, Total	0.005 :	0.005	1 / 8	0.007	0.007	0.0031	0.0031
SVOCs (mg/L)							
Di-n-octylphthalate	0.01 :	0.01	1 / 8	0.006	0.006	0.0051	0.0051
Phenol	0.01 :	0.01	1 / 8	0.001	0.001	0.0045	0.001
bis(2-EthylHexyl)phthalate	0.01 :	0.01	5 / 8	0.002	0.007	0.0046	0.0046
Metals (mg/L)							
Aluminum	0.1 :	0.1	5 / 8	0.17	21	4.6525	4.6525
Arsenic	0.005 :	0.005	3 / 8	0.006	0.25	0.0351	0.0351
Barium	0 :	0	7 / 7	0.007	0.055	0.0289	0.0289
Calcium	0 :	0	8 / 8	4	140	40.375	40.375
Chromium	0.015 :	0.015	2 / 8	0.077	0.13	0.0315	0.0315
Cobalt	0.015 :	0.015	1 / 8	0.02	0.02	0.0091	0.0091
Iron	0 :	0	8 / 8	0.38	72	10.3688	10.3688
Lead	0.005 :	0.005	1 / 8	0.18	0.18	0.0247	0.0247
Magnesium	0 :	0	8 / 8	1.8	3.9	3.075	3.075
Manganese	0 :	0	8 / 8	0.017	0.76	0.4696	0.4696
Mercury	0.0002 :	0.0002	1 / 8	0.0009	0.0009	0.0002	0.0002
Potassium	0 :	0	8 / 8	0.45	3.3	2.0338	2.0338

TABLE 57
SURFACE WATER EXPOSURE POINT CONCENTRATIONS - NON-HOT SPOT
FUTURE LAND USE (HISTORICAL DATA)

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
Sodium	0	0	8 / 8	7	260	53.75	53.75
Vanadium	0.025	0.025	1 / 8	0.19	0.19	0.0347	0.0347
Zinc	0.025	0.025	7 / 8	0.037	0.096	0.0552	0.0552
Inorganics (mg/L)							
Chloride	0	0	8 / 8	13	260	60.625	60.625
Nitrogen, Ammonia	0.1	0.1	6 / 8	0.34	22	3.4688	3.4688
Sulfate as SO4	0	0	8 / 8	26	390	150.25	150.25

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 5.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
The median represents the median value of all sample results, including non-detects, with the SQL used as the value for non-detects.
3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 58
SUMMARY SURFACE WATER EXPOSURE POINT CONCENTRATIONS
FUTURE LAND USE (HISTORICAL DATA)

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	EPCs for Exposure Points [2]		Area-Weighted EPCs for Exposure Points [3]		EPC Total Site [5]
	Non-hot spot	Hot spot	Non-hot spot	Hot spot	
	Fraction of Site Area [4]:		0.29	0.71	
VOCs (mg/L)					
1,1,1-Trichloroethane	0.0032	0.001	0.000928	0.00071	0.0016
1,2-Dichloroethene(total)	0	0.0033	0	0.002343	0.0023
2,4,4-Trimethyl-1-pentene	0.0088	0.0164	0.002552	0.011644	0.014
2,4,4-Trimethyl-2-Pentene	0.0051	0.0078	0.001479	0.005538	0.0070
4-Methyl-2-Pentanone (MIBK)	0	0.002	0	0.00142	0.0014
Acetone	0	0.0096	0	0.006816	0.0068
Bromoform	0	0.0023	0	0.001633	0.0016
Chloroethane	0.0061	0.002	0.001769	0.00142	0.0032
Ethylbenzene	0.0024	0.001	0.000696	0.00071	0.0014
Methylene Chloride	0.003	0.003	0.00087	0.00213	0.0030
Toluene	0.0057	0.0155	0.001653	0.011005	0.013
Trichloroethene (TCE)	0.001	0.0042	0.00029	0.002982	0.0033
Vinyl Chloride	0	0.002	0	0.00142	0.0014
Xylenes, Total	0.0031	0.0028	0.000899	0.001988	0.0029
SVOCs (mg/L)					
Di-n-octylphthalate	0.0051	0.0048	0.001479	0.003408	0.0049
N-Nitrosodiphenylamine	0	0.0053	0	0.003763	0.0038
Phenol	0.001	0.003	0.00029	0.00213	0.0024
bis(2-EthylHexyl)phthalate	0.0046	0.0165	0.001334	0.011715	0.013
Metals (mg/L)					
Aluminum	4.6525	4.7145	1.349225	3.347295	4.70
Arsenic	0.0351	0.0063	0.010179	0.004473	0.015
Barium	0.0289	0.0226	0.008381	0.016046	0.024
Calcium	40.375	30.445	11.70875	21.61595	33.3
Chromium	0.0315	0.9314	0.009135	0.661294	0.67
Cobalt	0.0091	0.0156	0.002639	0.011076	0.014
Copper	0	0.0179	0	0.012709	0.013
Hexavalent Chromium		0.0374	0	0.026554	0.027
Iron	10.3688	3.6234	3.006952	2.572614	5.58
Lead	0.0247	0.0059	0.007163	0.004189	0.011
Magnesium	3.075	6.2	0.89175	4.402	5.29
Manganese	0.4696	1.0112	0.136184	0.717952	0.85
Mercury	0.0002	0	0.000058	0	0.00
Nickel	0	0.026	0	0.01846	0.018
Potassium	2.0338	2.98	0.589802	2.1158	2.71
Sodium	53.75	114.75	15.5875	81.4725	97.1
Vanadium	0.0347	0	0.010063	0	0.010
Zinc	0.0552	0.0765	0.016008	0.054315	0.070

TABLE 58
SUMMARY SURFACE WATER EXPOSURE POINT CONCENTRATIONS
FUTURE LAND USE (HISTORICAL DATA)

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	EPCs for Exposure Points [2]		Area-Weighted EPCs for Exposure Points [3]		EPC Total Site [5]
	Non-hot spot	Hot spot	Non-hot spot	Hot spot	
	Fraction of Site Area [4]:		0.29	0.71	
Inorganics (mg/L)					
Chloride	60.625	127.45	17.58125	90.4895	108
Nitrate as N		3.7583	0	2.668393	2.67
Nitrite as N		0.0609	0	0.043239	0.043
Nitrogen, Ammonia	3.4688	37.023	1.005952	26.28633	27.3
Sulfate as SO4	150.25	271.35	43.5725	192.6585	236

Notes:
1 Selection of OHM of Concern for this medium are presented in Table 5.
2 EPCs for each exposure point are presented in the surface water exposure point concentration tables for future land use.
3 EPCs calculated by multiplying the EPC for the exposure point by the fractional site area of that exposure point.
4 Fractional site area represents the area of the exposure point divided by the area of the entire ditch (see surface water exposure point figure).
5 The final area-weighted EPC is the sum of the area-weighted EPCs for each exposure point.
"0" indicates that OHM was not detected in samples collected at exposure point.
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).
Non-hot spot is the portion of the on- and off-site ditch that is not a hot spot (EP28)
Hot spot is the portion of the on- and off-site ditch that is a hot spot (EP27)

TABLE 59
SEDIMENT EXPOSURE POINT CONCENTRATIONS - EAST DITCH
CURRENT LAND USE

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
VOCs (mg/Kg)							
1,1,1-Trichloroethane	0.007 :	0.04	1 / 18	47	47	2.6181	2.6181
1,1,2,2-Tetrachloroethane	0.002 :	0.04	2 / 17	0.004	0.016	0.0073	0.0073
1,1-Dichloroethane	0.007 :	0.04	6 / 18	0.003	0.019	0.0083	0.0083
1,2-Dichloroethene(total)	0.007 :	0.03	6 / 18	0.007	0.12	0.0153	0.0153
1,2-Dichloropropane	0.007 :	0.03	1 / 17	0.04	0.04	0.0086	0.0086
2,4,4-Trimethyl-1-pentene	0.02 :	0.05	14 / 18	0.004	0.2	0.0541	0.0541
2,4,4-Trimethyl-2-Pentene	0.01 :	0.05	11 / 18	0.002	1.1	0.0804	0.0804
2-Butanone (MEK)	0.02 :	0.08	2 / 17	0.091	0.28	0.0371	0.0371
Acetone	0.03 :	0.41	8 / 18	0.12	1.4	0.2288	0.2288
Benzene	0.007 :	0.04	4 / 18	0.003	0.018	0.0087	0.0087
Chlorobenzene	0.007 :	0.04	5 / 18	0.002	0.014	0.0073	0.0073
Ethylbenzene	0.007 :	0.04	1 / 17	0.005	0.005	0.0075	0.005
Methylene Chloride	0.01 :	0.08	3 / 17	0.004	0.008	0.0122	0.008
Styrene	0.007 :	0.04	1 / 17	0.005	0.005	0.0071	0.005
Tetrachloroethene (PCE)	0.007 :	0.04	2 / 17	0.007	0.01	0.0075	0.0075
Toluene	0.007 :	0.04	6 / 18	0.002	0.012	0.0069	0.0069
Trichloroethene (TCE)	0.007 :	0.03	12 / 18	0.002	0.15	0.0199	0.0199
Vinyl Chloride	0.01 :	0.08	3 / 18	0.002	0.012	0.0129	0.012
Xylenes, Total	0.007 :	0.04	3 / 17	0.003	0.02	0.0079	0.0079
SVOCs (mg/Kg)							
4-Bromophenyl-phenylether	0.4 :	3	1 / 17	0.23	0.23	0.5018	0.23
4-Chlorophenyl-phenylether	0.4 :	3	2 / 17	0.074	0.22	0.4938	0.22
Anthracene	0.5 :	3	10 / 17	0.033	0.52	0.3312	0.3312
Benzo(a)Anthracene	0.5 :	1	13 / 17	0.055	1.7	0.5473	0.5473
Benzo(a)Pyrene	0.5 :	1	13 / 17	0.059	2	0.5701	0.5701
Benzo(b)Fluoranthene	0.5 :	0.7	14 / 17	0.075	4.4	1.0074	1.0074

TABLE 59
SEDIMENT EXPOSURE POINT CONCENTRATIONS - EAST DITCH
CURRENT LAND USE

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]
Benzo(g,h,i)Perylene	0.5 :	3	11 / 17	0.056	2.1	0.5962	0.5962
Benzo(k)Fluoranthene	0.4 :	1	10 / 16	0.053	1.4	0.4046	0.4046
Benzoic Acid	2 :	10	4 / 17	0.45	3.4	1.9047	1.9047
Butylbenzylphthalate	0.4 :	3	5 / 16	0.066	0.49	0.4541	0.4541
Chrysene	0.5 :	1	14 / 17	0.093	3.4	0.9084	0.9084
Di-n-butylphthalate	0.4 :	5.8	8 / 18	0.075	0.5	0.5281	0.5
Di-n-octylphthalate	0.5 :	2	10 / 18	0.054	10	0.9952	0.9952
Dibenzo(a,h)Anthracene	0.4 :	3	2 / 17	0.41	0.43	0.4347	0.43
Dibenzofuran	0.4 :	3	2 / 17	0.11	0.22	0.4871	0.22
Fluoranthene	0.5 :	1	15 / 17	0.077	4.5	1.3545	1.3545
Fluorene	0.4 :	2	4 / 17	0.12	0.4	0.4247	0.4
Indeno (1,2,3-cd)Pyrene	0.5 :	1.3	12 / 17	0.069	2.7	0.5697	0.5697
N-Nitrosodiphenylamine	0.7 :	2	15 / 18	0.093	4.3	1.0529	1.0529
Naphthalene	0.4 :	3	2 / 18	0.053	53	3.4113	3.4113
Phenanthrene	0.5 :	3	12 / 17	0.06	1.9	0.7095	0.7095
Phenol	0.4 :	2	6 / 18	0.069	0.36	0.3438	0.3438
Pyrene	0.5 :	1	16 / 18	0.077	3.5	0.9787	0.9787
bis(2-EthylHexyl)phthalate	0 :	0	17 / 17	0.23	9300	756.6347	756.635
Pesticides/PCBs (mg/Kg)							
4,4'-DDD	0.004 :	2	1 / 18	0.007	0.007	0.0957	0.007
4,4'-DDT	0.006 :	2	2 / 18	0.0044	0.026	0.0965	0.026
Alpha-Chlordane	0.02 :	9	4 / 17	0.045	1.6	0.4851	0.4851
Delta-BHC	0.002 :	0.9	1 / 18	0.058	0.058	0.0487	0.0487
Endosulfan I	0.002 :	0.9	2 / 18	0.028	0.09	0.0504	0.0504
Endosulfan Sulfate	0.004 :	2	2 / 18	0.088	0.17	0.1056	0.1056
Endrin	0.004 :	2	2 / 18	0.0082	0.61	0.1157	0.1157
Endrin Aldehyde	0.006 :	0.5	5 / 18	0.02	6.5	0.4189	0.4189

TABLE 59
SEDIMENT EXPOSURE POINT CONCENTRATIONS - EAST DITCH
CURRENT LAND USE

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]
Endrin Ketone	0.004	2	2 / 18	0.011	0.4	0.1059	0.1059
Gamma-Chlordane	0.02	9	5 / 18	0.03	1.6	0.4623	0.4623
Metals (mg/Kg)							0
Aluminum	0	0	18 / 18	7.3	60000	10639.81	10639.8
Antimony	20	92	5 / 18	0.05	43	17.6299	17.6299
Arsenic	0	0	17 / 17	0.0053	440	104.2066	104.207
Barium	0	0	18 / 18	0.0097	250	52.7234	52.7234
Cadmium	0.001	1	9 / 17	1.1	14	2.4706	2.4706
Calcium	0	0	18 / 18	1	9900	2080.683	2080.68
Chromium	0	0	18 / 18	2.1	3000	622.8944	622.894
Cobalt	0	0	18 / 18	0.0044	39	10.0505	10.0505
Copper	0	0	17 / 17	0.02	280	75.3681	75.3681
Iron	0	0	18 / 18	6.8	140000	39739.79	39739.8
Lead	10	35	13 / 18	0.012	790	111.3073	111.307
Manganese	0	0	18 / 18	0.069	1900	360.9528	360.953
Mercury	0.0001	0.28	9 / 18	0.0001	1.3	0.3008	0.3008
Nickel	0	0	18 / 18	0.01	54	13.5962	13.5962
Potassium	0	0	18 / 18	0.34	1700	647.8189	647.819
Sodium	0	0	18 / 18	0.18	560	152.8	152.8
Vanadium	0	0	18 / 18	0.009	93	24.0622	24.0622
Zinc	0	0	18 / 18	0.026	1100	207.7258	207.726
Inorganics (mg/Kg)							
Chloride	40	40	11 / 18	0.064	240	58.5663	58.5663
Nitrate as N	1	1	2 / 3	0.0014	0.0015	0.1676	0.0015
Nitrogen, Ammonia	8	8	15 / 17	0.16	410	100.2447	100.245
Sulfate as SO4	0	0	18 / 18	110	18000	2103.889	2103.89

TABLE 59
SEDIMENT EXPOSURE POINT CONCENTRATIONS - EAST DITCH
CURRENT LAND USE

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 7.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 60
SEDIMENT EXPOSURE POINT CONCENTRATIONS - ON-SITE DITCH
CURRENT LAND USE

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]
VOCs (mg/Kg)							
1,1,2,2-Tetrachloroethane	0.005 :	1	2 / 24	0.002	0.003	0.026	0.003
1,1-Dichloroethane	0.005 :	1	4 / 24	0.003	0.034	0.0269	0.0269
2,4,4-Trimethyl-1-pentene	0.01 :	0.02	18 / 24	0.002	28	2.7831	2.7831
2,4,4-Trimethyl-2-Pentene	0.01 :	0.02	16 / 24	0.002	9.4	0.8529	0.8529
2-Butanone (MEK)	0.015 :	3	6 / 24	0.012	0.074	0.085	0.074
2-Hexanone	0.015 :	3	2 / 24	0.02	0.036	0.0791	0.036
Acetone	0.02 :	3	9 / 24	0.007	1.7	0.1836	0.1836
Benzene	0.005 :	1	1 / 24	0.015	0.015	0.0266	0.015
Carbon Disulfide	0.01 :	2	3 / 24	0.003	0.005	0.0513	0.005
Chlorobenzene	0.005 :	1	1 / 24	0.007	0.007	0.0263	0.007
Ethylbenzene	0.005 :	0.046	6 / 24	0.003	0.71	0.0396	0.0396
Methylene Chloride	0.01 :	2	7 / 24	0.004	0.024	0.0521	0.024
Styrene	0.005 :	1	2 / 24	0.004	0.007	0.0263	0.007
Tetrachloroethene (PCE)	0.005 :	1	2 / 24	0.007	0.032	0.0266	0.0266
Toluene	0.005 :	1	8 / 24	0.002	1.1	0.0719	0.0719
Xylenes, Total	0.005 :	1	6 / 24	0.002	0.25	0.0366	0.0366
SVOCs (mg/Kg)							
1,2,4-Trichlorobenzene	0.4 :	1200	5 / 29	0.083	1.4	49.6234	1.4
1,2-Dichlorobenzene	0.4 :	1200	1 / 29	1.6	1.6	49.6902	1.6
2-Methylnaphthalene	0.4 :	1200	1 / 29	1.4	1.4	49.6833	1.4
4-Bromophenyl-phenylether	0.4 :	1200	5 / 29	0.47	3.4	49.9371	3.4
4-Chlorophenyl-phenylether	0.4 :	1200	4 / 29	0.23	2.3	49.7895	2.3
Benzo(a)Anthracene	0.4 :	1200	2 / 29	0.095	2.1	49.7848	2.1
Benzo(a)Pyrene	0.4 :	1200	1 / 29	0.1	0.1	49.7988	0.1
Benzo(b)Fluoranthene	0.4 :	1200	5 / 29	0.064	0.87	49.7192	0.87
Benzo(g,h,i)Perylene	0.4 :	1200	1 / 29	0.083	0.083	49.7982	0.083

TABLE 60
SEDIMENT EXPOSURE POINT CONCENTRATIONS - ON-SITE DITCH
CURRENT LAND USE

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]
Benzoic Acid	2 :	5800	4 / 28	0.11	2	248.4971	2
Butylbenzylphthalate	0.4 :	1200	12 / 29	0.33	160	57.6357	57.6357
Chrysene	0.4 :	1200	3 / 29	0.1	1.3	49.7881	1.3
Di-n-butylphthalate	0.4 :	1200	13 / 29	0.016	2100	154.8332	154.833
Di-n-octylphthalate	0.4 :	1200	12 / 29	0.091	24	50.7106	24
Dibenzofuran	0.4 :	1200	2 / 29	1.6	5.9	49.8074	5.9
Dimethylphthalate	0.4 :	1200	3 / 29	0.12	0.53	49.7602	0.53
Fluoranthene	0.4 :	1200	10 / 29	0.065	4.1	49.6732	4.1
Fluorene	0.4 :	1200	2 / 29	0.092	4	49.7675	4
Indeno (1,2,3-cd)Pyrene	0.4 :	1200	3 / 29	0.091	13	50.2433	13
N-Nitrosodiphenylamine	0.4 :	550	16 / 29	0.24	6200	422.6209	422.621
Naphthalene	0.4 :	1200	1 / 29	2.2	2.2	49.7109	2.2
Phenanthrene	0.4 :	1200	12 / 29	0.054	34	51.2749	34
Phenol	0.4 :	1100	7 / 29	0.075	56	31.0897	31.0897
Pyrene	0.4 :	1200	11 / 29	0.07	9.1	49.8667	9.1
bis(2-EthylHexyl)phthalate	0.8 :	37	26 / 29	0.082	150000	11092.86	11092.9
Pesticides/PCBs (mg/Kg)							
4,4'-DDT	0.004 :	0.6	3 / 29	0.018	1.2	0.0958	0.0958
Aldrin	0.002 :	0.3	4 / 29	0.046	0.45	0.0469	0.0469
Alpha-Chlordane	0.0022 :	3	1 / 29	0.025	0.025	0.238	0.025
Beta-BHC	0.002 :	0.3	1 / 28	0.46	0.46	0.0438	0.0438
Endosulfan I	0.002 :	0.3	3 / 29	0.0032	0.41	0.0409	0.0409
Endosulfan Sulfate	0.004 :	0.6	3 / 29	0.047	0.12	0.0693	0.0693
Endrin	0.004 :	0.6	1 / 29	0.035	0.035	0.0593	0.035
Endrin Aldehyde	0.004 :	0.6	6 / 29	0.055	2.5	0.1578	0.1578
Endrin Ketone	0.004 :	0.6	1 / 29	0.065	0.065	0.0641	0.0641
Heptachlor	0.002 :	0.3	3 / 29	0.0006	0.54	0.0441	0.0441

TABLE 60
SEDIMENT EXPOSURE POINT CONCENTRATIONS - ON-SITE DITCH
CURRENT LAND USE

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
Heptachlor Epoxide	0.002 :	0.3	2 / 29	0.0046	0.006	0.0319	0.006
Methoxychlor	0.02 :	3	1 / 29	0.29	0.29	0.3228	0.29
Metals (mg/Kg)							
Aluminum	0 :	0	29 / 29	570	66700	7444.483	7444.48
Antimony	20 :	31	14 / 29	1.1	69	20.7966	20.7966
Arsenic	0.5 :	0.5	28 / 29	1.1	26.4	4.7845	4.7845
Barium	0 :	0	29 / 29	4.6	74	19.131	19.131
Beryllium	0.3 :	2.4	4 / 29	0.22	10.4	1.0353	1.0353
Cadmium	0.21 :	1.6	3 / 29	0.4	2.7	0.6029	0.6029
Calcium	0 :	0	29 / 29	160	7570	1191.655	1191.66
Chromium	0 :	0	29 / 29	5.4	13800	1382.772	1382.77
Cobalt	1.5 :	2.4	20 / 29	1.5	38.4	5.3172	5.3172
Copper	2.5 :	2.5	26 / 29	2.2	97.7	13.5328	13.5328
Iron	0 :	0	29 / 29	330	67500	7623.104	7623.1
Lead	10 :	12	13 / 28	2.3	59.7	13.6179	13.6179
Manganese	0 :	0	29 / 29	3.7	95	41.4862	41.4862
Mercury	0.086 :	0.26	13 / 29	0.11	1.2	0.2198	0.2198
Nickel	4 :	6.3	18 / 29	4.3	110	10.6535	10.6535
Potassium	0 :	0	29 / 29	130	960	306.6552	306.655
Selenium	0.5 :	2.9	1 / 29	0.78	0.78	0.3928	0.3928
Silver	0.83 :	2.9	2 / 29	2.7	5.8	1.0288	1.0288
Sodium	0 :	0	29 / 29	28	500	184.1379	184.138
Vanadium	2.5 :	2.5	27 / 29	3.6	50.3	12.8931	12.8931
Zinc	2.5 :	2.5	28 / 29	3.9	372	43.5535	43.5535

TABLE 60
SEDIMENT EXPOSURE POINT CONCENTRATIONS - ON-SITE DITCH
CURRENT LAND USE

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]
Inorganics (mg/Kg)							
Chloride	40 :	40	16 / 23	44	240	75	75
Nitrate as N	0 :	0	2 / 2	2.8	3.7	3.25	3.25
Nitrite as N	1 :	1	1 / 2	2.2	2.2	1.35	1.35
Nitrogen, Ammonia	8 :	8	27 / 28	18	410	117	117
Sulfate as SO4	40 :	40	22 / 23	80	3200	553.3044	553.304

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 7.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 61
SEDIMENT EXPOSURE POINT CONCENTRATIONS - WEST DITCH OFF-SITE
CURRENT LAND USE

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]
VOCs (mg/Kg)							
1,1,1-Trichloroethane	0.007	0.02	4 / 9	0.006	0.0185	0.0074	0.0074
1,1-Dichloroethane	0.007	0.02	2 / 8	0.003	0.004	0.0048	0.004
2,4,4-Trimethyl-1-pentene	0.01	0.01	8 / 9	0.006	6.5	0.9176	0.9176
2,4,4-Trimethyl-2-Pentene	0.01	0.01	8 / 9	0.003	1.8	0.2589	0.2589
Acetone	0.015	0.092	4 / 9	0.009	0.093	0.0301	0.0301
Bromoform	0.007	0.01	5 / 8	0.003	0.102	0.0265	0.0265
Carbon Tetrachloride	0.007	0.01	2 / 8	0.005	0.011	0.0052	0.0052
Chloroform	0.007	0.01	5 / 8	0.003	0.009	0.0048	0.0048
Dibromochloromethane	0.007	0.02	3 / 8	0.004	0.026	0.0094	0.0094
Methylene Chloride	0.01	0.05	1 / 9	0.01	0.01	0.0097	0.0097
Tetrachloroethene (PCE)	0.007	0.02	2 / 8	0.003	0.004	0.0047	0.004
Toluene	0.007	0.02	3 / 8	0.009	0.012	0.0066	0.0066
Trichloroethene (TCE)	0.007	0.02	3 / 8	0.002	0.003	0.0042	0.003
Xylenes, Total	0.007	0.02	1 / 8	0.006	0.006	0.005	0.005
SVOCs (mg/Kg)							
1,2,4-Trichlorobenzene	0.4	0.9	2 / 9	0.076	0.21	0.2484	0.21
4-Bromophenyl-phenylether	0.4	0.9	6 / 9	0.15	0.65	0.3878	0.3878
4-Chlorophenyl-phenylether	0.4	1	2 / 9	0.058	0.1	0.2866	0.1
Benzo(a)Anthracene	0.4	0.9	4 / 9	0.11	0.49	0.2933	0.2933
Benzo(a)Pyrene	0.4	0.9	4 / 9	0.14	0.6	0.3317	0.3317
Benzo(b)Fluoranthene	0.4	0.9	5 / 9	0.052	1.2	0.4868	0.4868
Benzo(g,h,i)Perylene	0.4	0.9	3 / 9	0.28	0.45	0.3111	0.3111
Benzo(k)Fluoranthene	0.4	0.9	2 / 9	0.077	0.29	0.2726	0.2726
Benzoic Acid	2	7	1 / 9	0.17	0.17	1.565	0.17
Chrysene	0.4	0.9	4 / 9	0.2	0.73	0.3806	0.3806
Di-n-butylphthalate	0.4	1	1 / 9	0.086	0.086	0.2929	0.086

TABLE 61
SEDIMENT EXPOSURE POINT CONCENTRATIONS - WEST DITCH OFF-SITE
CURRENT LAND USE

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
Dibenzo(a,h)Anthracene	0.4 :	1	1 / 9	0.12	0.12	0.2911	0.12
Fluoranthene	0.4 :	0.4	6 / 9	0.083	1.7	0.7063	0.7063
Indeno (1,2,3-cd)Pyrene	0.4 :	0.9	6 / 9	0.14	0.56	0.3161	0.3161
N-Nitrosodiphenylamine	0.4 :	0.9	4 / 9	0.18	0.91	0.3983	0.3983
Phenanthrene	0.4 :	0.9	6 / 9	0.13	0.57	0.2989	0.2989
Pyrene	0.4 :	0.4	7 / 9	0.167	1.1	0.4541	0.4541
bis(2-EthylHexyl)phthalate	0.4 :	0.9	7 / 9	0.325	2.92	1.2322	1.2322
Pesticides/PCBs (mg/Kg)							
4,4'-DDD	0.004 :	0.07	1 / 9	0.19	0.19	0.0296	0.0296
Alpha-BHC	0.002 :	0.08	1 / 8	0.0052	0.0052	0.0105	0.0052
Beta-BHC	0.002 :	0.04	4 / 8	0.0031	0.21	0.032	0.032
Delta-BHC	0.002 :	0.04	5 / 8	0.0054	0.12	0.0263	0.0263
Endosulfan I	0.002 :	0.04	2 / 8	0.0032	0.15	0.0241	0.0241
Endosulfan Sulfate	0.004 :	0.07	2 / 9	0.074	0.24	0.0406	0.0406
Endrin Aldehyde	0.004 :	0.2	3 / 9	0.012	0.012	0.0211	0.012
Heptachlor Epoxide	0.002 :	0.04	2 / 8	0.033	0.16	0.0275	0.0275
Metals (mg/Kg)							
Aluminum	0 :	0	9 / 9	3100	150000	27766.67	27766.7
Antimony	20 :	20	5 / 8	99	250	83	83
Arsenic	23 :	23	8 / 9	1.7	11	6.1833	6.1833
Barium	0 :	0	9 / 9	3.6	24	11.8333	11.8333
Beryllium	1.5 :	3.5	1 / 8	1.9	1.9	1.0438	1.0438
Cadmium	1 :	2.4	1 / 8	2.1	2.1	0.8	0.8
Calcium	0 :	0	9 / 9	360	1200	631.1111	631.111
Chromium	0 :	0	9 / 9	140	8900	2744.444	2744.44
Cobalt	1.5 :	1.5	8 / 9	1.5	6.6	3.6111	3.6111
Copper	0 :	0	8 / 8	4.1	120	34.8781	34.8781

TABLE 61
SEDIMENT EXPOSURE POINT CONCENTRATIONS - WEST DITCH OFF-SITE
CURRENT LAND USE

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]
Iron	0	0	9 / 9	3200	83000	18305.56	18305.6
Lead	10	10	4 / 8	10	100	21.875	21.875
Manganese	0	0	9 / 9	27	97	52	52
Mercury	0.1	0.2	2 / 9	0.21	0.96	0.1814	0.1814
Nickel	4	4	7 / 9	5.3	14	6.6861	6.6861
Potassium	0	0	9 / 9	330	1200	621.1111	621.111
Sodium	0	0	9 / 9	32	1600	511.5556	511.556
Vanadium	0	0	9 / 9	4.1	31	13.9889	13.9889
Zinc	0	0	9 / 9	8.1	60	20.3167	20.3167
Inorganics (mg/Kg)							
Chloride	40	40	8 / 9	60	1400	375.5	375.5
Nitrate as N	0	0	2 / 2	2.6	3.15	2.875	2.875
Nitrogen, Ammonia	8	8	6 / 8	75	1000	225.375	225.375
Sulfate as SO4	0	0	9 / 9	100	6000	1326.111	1326.11

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 7.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.
EPC = *Exposure Point Concentration*
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 62
SEDIMENT EXPOSURE POINT CONCENTRATIONS - HOT SPOT
FUTURE LAND USE

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]
VOCs (mg/Kg)							
1,1,1-Trichloroethane	0.007 :	1	5 / 35	0.006	47	1.3638	1.3638
1,1,2,2-Tetrachloroethane	0.002 :	1	3 / 33	0.002	0.004	0.0212	0.004
1,1-Dichloroethane	0.007 :	1	11 / 34	0.003	0.034	0.0215	0.0215
1,2-Dichloroethene(total)	0.007 :	1	6 / 34	0.007	0.12	0.0252	0.0252
1,2-Dichloropropane	0.007 :	1	1 / 33	0.04	0.04	0.022	0.022
2,4,4-Trimethyl-1-pentene	0.02 :	0.05	32 / 35	0.009	28	2.1672	2.1672
2,4,4-Trimethyl-2-Pentene	0.01 :	0.05	31 / 35	0.002	9.4	0.6886	0.6886
2-Butanone (MEK)	0.02 :	3	7 / 33	0.012	0.28	0.0755	0.0755
2-Hexanone	0.02 :	3	2 / 33	0.02	0.036	0.0643	0.036
Acetone	0.02 :	3	16 / 35	0.009	1.7	0.1963	0.1963
Benzene	0.007 :	1	5 / 34	0.003	0.018	0.022	0.018
Bromoform	0.007 :	1	5 / 33	0.003	0.102	0.0266	0.0266
Carbon Disulfide	0.01 :	10	3 / 34	0.003	0.005	0.1882	0.005
Carbon Tetrachloride	0.007 :	1	2 / 33	0.005	0.011	0.0215	0.011
Chlorobenzene	0.007 :	1	6 / 34	0.002	0.014	0.021	0.014
Chloroform	0.007 :	1	5 / 33	0.003	0.009	0.0214	0.009
Dibromochloromethane	0.007 :	1	3 / 33	0.004	0.026	0.0225	0.0225
Ethylbenzene	0.007 :	0.046	7 / 33	0.003	0.71	0.0312	0.0312
Methylene Chloride	0.01 :	2	7 / 34	0.004	0.022	0.0408	0.022
Styrene	0.007 :	1	3 / 33	0.004	0.007	0.0213	0.007
Tetrachloroethene (PCE)	0.007 :	1	6 / 33	0.003	0.032	0.0218	0.0218
Toluene	0.007 :	1	12 / 34	0.002	1.1	0.0538	0.0538
Trichloroethene (TCE)	0.007 :	1	13 / 34	0.002	0.15	0.0275	0.0275
Vinyl Chloride	0.01 :	2	3 / 34	0.002	0.012	0.0416	0.012
Xylenes, Total	0.007 :	1	9 / 33	0.002	0.25	0.0293	0.0293
SVOCs (mg/Kg)							
1,2,4-Trichlorobenzene	0.4 :	1200	7 / 41	0.076	1.4	44.9835	1.4
1,2-Dichlorobenzene	0.4 :	1200	1 / 41	1.6	1.6	45.0433	1.6

TABLE 62
SEDIMENT EXPOSURE POINT CONCENTRATIONS - HOT SPOT
FUTURE LAND USE

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]
2-Methylnaphthalene	0.4 :	1200	1 / 41	1.4	1.4	45.0372	1.4
4-Bromophenyl-phenylether	0.4 :	1200	11 / 41	0.15	3.4	45.236	3.4
4-Chlorophenyl-phenylether	0.4 :	1200	6 / 41	0.058	2.3	45.1094	2.3
Anthracene	0.4 :	1200	6 / 41	0.028	0.17	45.0826	0.17
Benzo(a)Anthracene	0.4 :	1200	13 / 41	0.055	2.1	45.0803	2.1
Benzo(a)Pyrene	0.4 :	1200	12 / 41	0.059	0.65	45.0972	0.65
Benzo(b)Fluoranthene	0.4 :	1200	17 / 41	0.052	1.2	45.1128	1.2
Benzo(g,h,i)Perylene	0.4 :	1200	9 / 41	0.059	0.58	45.1011	0.58
Benzo(k)Fluoranthene	0.4 :	1200	7 / 40	0.077	0.41	46.1837	0.41
Benzoic Acid	2 :	5800	7 / 40	0.11	3.4	223.2714	3.4
Butylbenzylphthalate	0.4 :	1200	17 / 40	0.066	160	51.8965	51.8965
Chrysene	0.4 :	1200	15 / 41	0.093	1.3	45.1462	1.3
Di-n-butylphthalate	0.4 :	1200	19 / 42	0.016	2100	116.6124	116.612
Di-n-octylphthalate	0.4 :	1200	19 / 42	0.054	24	44.8898	24
Dibenzo(a,h)Anthracene	0.4 :	1200	1 / 41	0.12	0.12	45.1231	0.12
Dibenzofuran	0.4 :	1200	2 / 41	1.6	5.9	45.125	5.9
Dimethylphthalate	0.4 :	1200	3 / 41	0.12	0.53	45.0916	0.53
Fluoranthene	0.4 :	1200	24 / 41	0.065	4.1	45.1958	4.1
Fluorene	0.4 :	1200	4 / 41	0.092	4	45.0668	4
Indeno (1,2,3-cd)Pyrene	0.4 :	1200	16 / 41	0.069	13	45.3985	13
N-Nitrosodiphenylamine	0.4 :	550	30 / 42	0.12	6200	298.6483	298.648
Naphthalene	0.4 :	1200	1 / 41	2.2	2.2	45.0567	2.2
Phenanthrene	0.4 :	1200	24 / 41	0.054	34	46.1476	34
Phenol	0.4 :	1100	13 / 42	0.069	56	31.0714	31.0714
Pyrene	0.4 :	1200	26 / 42	0.076	9.1	44.1587	9.1
bis(2-EthylHexyl)phthalate	0.9 :	37	39 / 41	0.26	150000	8303.369	8303.37
Pesticides/PCBs (mg/Kg)							
4,4'-DDD	0.004 :	0.6	2 / 42	0.007	0.19	0.0653	0.0653
4,4'-DDT	0.004 :	0.6	4 / 42	0.0044	1.2	0.086	0.086

TABLE 62
SEDIMENT EXPOSURE POINT CONCENTRATIONS - HOT SPOT
FUTURE LAND USE

Olin Corporation
Wilmington, MA Facility

	Site Data/Concentration [2]						
OHM of Concern [1]	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]
Aldrin	0.002 :	0.3	4 / 41	0.046	0.45	0.0439	0.0439
Alpha-BHC	0.002 :	0.3	1 / 41	0.0052	0.0052	0.0332	0.0052
Alpha-Chlordane	0.0022 :	3	5 / 41	0.025	1.6	0.2669	0.2669
Beta-BHC	0.002 :	0.3	5 / 41	0.0031	0.46	0.045	0.045
Delta-BHC	0.002 :	0.3	6 / 41	0.0054	0.12	0.0371	0.0371
Endosulfan I	0.002 :	0.3	6 / 41	0.0032	0.41	0.0438	0.0438
Endosulfan Sulfate	0.004 :	0.6	7 / 42	0.047	0.24	0.0765	0.0765
Endrin	0.004 :	0.6	3 / 42	0.0082	0.61	0.0694	0.0694
Endrin Aldehyde	0.004 :	0.6	12 / 42	0.012	2.5	0.1321	0.1321
Endrin Ketone	0.004 :	0.6	3 / 42	0.011	0.4	0.0685	0.0685
Gamma-Chlordane	0.0022 :	3	5 / 41	0.0036	1.6	0.2691	0.2691
Heptachlor	0.002 :	0.3	3 / 41	0.0006	0.54	0.042	0.042
Heptachlor Epoxide	0.002 :	0.3	3 / 41	0.0046	0.16	0.0366	0.0366
Methoxychlor	0.02 :	3	1 / 41	0.29	0.29	0.3361	0.29
Metals (mg/Kg)							
Aluminum	0 :	0	42 / 42	7.3	150000	13582.06	13582.1
Antimony	0.96 :	92	25 / 41	0.05	250	33.5297	33.5297
Arsenic	23 :	23	40 / 41	0.0053	440	35.7893	35.7893
Barium	0 :	0	42 / 42	0.0097	250	31.6862	31.6862
Beryllium	0.0015 :	6.9	7 / 40	0.22	10.4	1.0864	1.0864
Cadmium	0.001 :	2.4	10 / 40	0.4	14	1.2081	1.2081
Calcium	0 :	0	42 / 42	1	9900	1482.674	1482.67
Chromium	0 :	0	42 / 42	2.1	13800	1826.56	1826.56
Cobalt	1.5 :	1.5	39 / 42	0.0044	39	6.8764	6.8764
Copper	2.5 :	2.5	39 / 40	0.02	280	36.0358	36.0358
Iron	0 :	0	42 / 42	6.8	130000	18142.53	18142.5
Lead	10 :	10	26 / 41	0.012	790	56.8788	56.8788
Manganese	0 :	0	42 / 42	0.069	1900	130.5822	130.582
Mercury	0.0001 :	0.28	23 / 42	0.0001	1.3	0.2891	0.2891

TABLE 62
SEDIMENT EXPOSURE POINT CONCENTRATIONS - HOT SPOT
FUTURE LAND USE

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]
Nickel	4 :	4	38 / 42	0.01	110	12.5906	12.5906
Potassium	0 :	0	42 / 42	0.34	1600	429.6605	429.661
Silver	0.0015 :	6.9	1 / 40	2.7	2.7	0.9364	0.9364
Sodium	0 :	0	42 / 42	0.18	1600	276.5571	276.557
Vanadium	2.5 :	2.5	41 / 42	0.009	93	16.2636	16.2636
Zinc	0 :	0	42 / 42	0.026	1100	109.7075	109.708
Inorganics (mg/Kg)							
Chloride	40 :	40	31 / 34	0.064	1400	166.6087	166.609
Nitrate as N	1 :	1	6 / 7	0.0014	3.7	1.8218	1.8218
Nitrite as N	0.001 :	1	1 / 6	2.2	2.2	0.7001	0.7001
Nitrogen, Ammonia	8 :	8	37 / 39	0.16	1000	174.099	174.099
Sulfate as SO4	0 :	0	34 / 34	96	18000	1597.677	1597.68

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 7.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 63
SEDIMENT EXPOSURE POINT CONCENTRATIONS - NON-HOT SPOT
FUTURE LAND USE

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]
VOCs (mg/Kg)							
1,1,2,2-Tetrachloroethane	0.005	0.03	1 / 17	0.016	0.016	0.0054	0.0054
1,1-Dichloroethane	0.005	0.03	1 / 17	0.019	0.019	0.0061	0.0061
2,4,4-Trimethyl-1-pentene	0.01	0.05	8 / 17	0.002	0.028	0.0106	0.0106
2,4,4-Trimethyl-2-Pentene	0.01	0.05	4 / 17	0.002	0.012	0.0088	0.0088
2-Butanone (MEK)	0.015	0.08	1 / 16	0.091	0.091	0.019	0.019
Acetone	0.015	0.41	6 / 17	0.007	0.58	0.1149	0.1149
Methylene Chloride	0.01	0.05	5 / 17	0.005	0.024	0.0099	0.0099
Toluene	0.005	0.03	5 / 17	0.002	0.006	0.0045	0.0045
Trichloroethene (TCE)	0.005	0.03	2 / 17	0.002	0.007	0.0053	0.0053
Xylenes, Total	0.005	0.03	1 / 17	0.004	0.004	0.0052	0.004
SVOCs (mg/Kg)							
2-Methylnaphthalene	0.4	2	1 / 17	0.067	0.067	0.3422	0.067
4-Bromophenyl-phenylether	0.4	2	1 / 17	0.23	0.23	0.3488	0.23
4-Chlorophenyl-phenylether	0.4	2	2 / 17	0.074	0.22	0.3408	0.22
Anthracene	0.4	0.8	6 / 17	0.055	0.52	0.2732	0.2732
Benzo(a)Anthracene	0.4	0.8	8 / 17	0.095	1.7	0.4825	0.4825
Benzo(a)Pyrene	0.4	0.8	8 / 17	0.078	2	0.5122	0.5122
Benzo(b)Fluoranthene	0.4	0.8	9 / 17	0.069	4.4	0.8876	0.8876
Benzo(g,h,i)Perylene	0.4	0.8	8 / 17	0.056	2.1	0.4929	0.4929
Benzo(k)Fluoranthene	0.4	0.8	7 / 17	0.053	1.4	0.3949	0.3949
Benzoic Acid	2	8	3 / 17	0.085	2.5	1.4479	1.4479
Chrysene	0.4	0.8	8 / 17	0.14	3.4	0.7577	0.7577
Di-n-butylphthalate	0.4	2	3 / 17	0.086	0.23	0.2939	0.23
Di-n-octylphthalate	0.4	2	3 / 17	0.17	1.4	0.3712	0.3712
Dibenzo(a,h)Anthracene	0.4	0.8	3 / 17	0.12	0.43	0.2771	0.2771
Dibenzofuran	0.4	2	3 / 17	0.098	0.22	0.3281	0.22

TABLE 63
SEDIMENT EXPOSURE POINT CONCENTRATIONS - NON-HOT SPOT
FUTURE LAND USE

Olin Corporation
Wilmington, MA Facility

	Site Data/Concentration [2]						
OHM of Concern [1]	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]
Fluoranthene	0.4 :	0.8	9 / 17	0.079	4.5	1.1294	1.1294
Fluorene	0.4 :	2	3 / 17	0.2	0.3	0.3441	0.3
Indeno (1,2,3-cd)Pyrene	0.4 :	1.3	7 / 17	0.076	2.7	0.5181	0.5181
N-Nitrosodiphenylamine	0.4 :	2	7 / 17	0.06	0.82	0.3284	0.3284
Naphthalene	0.4 :	2	3 / 18	0.053	53	3.2598	3.2598
Phenanthrene	0.4 :	0.8	8 / 17	0.062	1.9	0.6342	0.6342
Pyrene	0.4 :	0.8	10 / 17	0.07	3.5	0.8725	0.8725
bis(2-EthylHexyl)phthalate	0.4 :	2.7	13 / 17	0.082	440	37.0555	37.0555
Pesticides/PCBs (mg/Kg)							
4,4'-DDT	0.004 :	2	1 / 17	0.018	0.018	0.0682	0.018
Endosulfan I	0.002 :	0.9	1 / 17	0.0081	0.0081	0.0313	0.0081
Endrin Aldehyde	0.004 :	0.05	2 / 17	0.23	6.5	0.4023	0.4023
Gamma-Chlordane	0.02 :	9	1 / 17	0.03	0.03	0.305	0.03
Heptachlor Epoxide	0.002 :	0.04	1 / 16	0.006	0.006	0.005	0.005
Metals (mg/Kg)							
Aluminum	0 :	0	17 / 17	570	19000	5839.412	5839.41
Arsenic	0.5 :	0.5	16 / 17	1.6	190	30.6265	30.6265
Barium	0 :	0	17 / 17	3.6	45	18.4647	18.4647
Cadmium	1 :	1.6	3 / 17	1.8	5	1.0765	1.0765
Calcium	0 :	0	17 / 17	160	3000	1005.882	1005.88
Chromium	0 :	0	17 / 17	5.4	320	56.5882	56.5882
Cobalt	1.5 :	2.4	10 / 17	1.5	27	4.9765	4.9765
Copper	2.5 :	2.5	15 / 17	3.6	190	31.6059	31.6059
Iron	0 :	0	17 / 17	330	140000	21166.47	21166.5
Lead	10 :	35	7 / 16	15	60	16.0313	16.0313
Manganese	0 :	0	17 / 17	3.7	1500	165.3824	165.382
Mercury	0.1 :	0.26	2 / 17	0.34	0.39	0.0956	0.0956

TABLE 63
SEDIMENT EXPOSURE POINT CONCENTRATIONS - NON-HOT SPOT
FUTURE LAND USE

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	
Nickel	4 :	6.3	8 / 17	5.3	18	5.8029	5.8029
Potassium	0 :	0	17 / 17	140	1700	518.2353	518.235
Selenium	0.5 :	5.9	1 / 17	0.78	0.78	0.6994	0.6994
Silver	1.5 :	5.3	1 / 17	5.8	5.8	1.3	1.3
Sodium	0 :	0	17 / 17	28	250	91.3529	91.3529
Vanadium	2.5 :	2.5	16 / 17	3.6	73	16.0088	16.0088
Zinc	2.5 :	2.5	16 / 17	3.9	170	40.4382	40.4382
Inorganics (mg/Kg)							
Chloride	40 :	40	4 / 17	46	98	30.2353	30.2353
Nitrogen, Ammonia	8 :	8	14 / 17	12	130	38.5882	38.5882
Sulfate as SO4	40 :	40	16 / 17	80	3900	665.2941	665.294

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 7.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 64
SUMMARY SEDIMENT EXPOSURE POINT CONCENTRATIONS - FUTURE LAND USE

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	EPCs for Exposure Points [2]		Area-Weighted EPCs for Exposure Points [3]		EPC Total Site [5]
	Non-hot spot	Hot spot	Non-hot spot	Hot spot	
	Fraction of Site Area [4]:		0.26	0.74	
VOCs (mg/Kg)					
1,1,1-Trichloroethane	0	1.3638	0	1.009212	1.01
1,1,2,2-Tetrachloroethane	0.0054	0.004	0.001404	0.00296	0.0044
1,1-Dichloroethane	0.0061	0.0215	0.001586	0.01591	0.017
1,2-Dichloroethene(total)	0	0.0252	0	0.018648	0.019
1,2-Dichloropropane	0	0.022	0	0.01628	0.016
2,4,4-Trimethyl-1-pentene	0.0106	2.1672	0.002756	1.603728	1.61
2,4,4-Trimethyl-2-Pentene	0.0088	0.6886	0.002288	0.509564	0.51
2-Butanone (MEK)	0.019	0.0755	0.00494	0.05587	0.061
2-Hexanone	0	0.036	0	0.02664	0.027
Acetone	0.1149	0.1963	0.029874	0.145262	0.18
Benzene	0	0.018	0	0.01332	0.013
Bromodichloromethane	0	0.0065	0	0.00481	0.0048
Bromoform	0	0.0266	0	0.019684	0.020
Carbon Disulfide	0	0.005	0	0.0037	0.0037
Carbon Tetrachloride	0	0.011	0	0.00814	0.0081
Chlorobenzene	0	0.014	0	0.01036	0.010
Chloroform	0	0.009	0	0.00666	0.0067
Dibromochloromethane	0	0.0225	0	0.01665	0.017
Ethylbenzene	0	0.0312	0	0.023088	0.023
Methylene Chloride	0.0099	0.022	0.002574	0.01628	0.019
Styrene	0	0.007	0	0.00518	0.0052
Tetrachloroethene (PCE)	0	0.0218	0	0.016132	0.016
Toluene	0.0045	0.0538	0.00117	0.039812	0.041
Trichloroethene (TCE)	0.0053	0.0275	0.001378	0.02035	0.022
Vinyl Chloride	0	0.012	0	0.00888	0.0089
Xylenes, Total	0.004	0.0293	0.00104	0.021682	0.023
SVOCs (mg/Kg)					
1,2,4-Trichlorobenzene	0	1.4	0	1.036	1.04
1,2-Dichlorobenzene	0	1.6	0	1.184	1.18
2-Methylnaphthalene	0.067	1.4	0.01742	1.036	1.05
4-Bromophenyl-phenylether	0.23	3.4	0.0598	2.516	2.58
4-Chlorophenyl-phenylether	0.22	2.3	0.0572	1.702	1.76
Anthracene	0.2732	0.17	0.071032	0.1258	0.20
Benzo(a)Anthracene	0.4825	2.1	0.12545	1.554	1.68
Benzo(a)Pyrene	0.5122	0.65	0.133172	0.481	0.61
Benzo(b)Fluoranthene	0.8876	1.2	0.230776	0.888	1.12
Benzo(g,h,i)Perylene	0.4929	0.58	0.128154	0.4292	0.56
Benzo(k)Fluoranthene	0.3949	0.41	0.102674	0.3034	0.41
Benzoic Acid	1.4479	3.4	0.376454	2.516	2.89
Butylbenzylphthalate	0	51.8965	0	38.40341	38.4

TABLE 64
SUMMARY SEDIMENT EXPOSURE POINT CONCENTRATIONS - FUTURE LAND USE

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	EPCs for Exposure Points [2]		Area-Weighted EPCs for Exposure Points [3]		EPC Total Site [5]
	Non-hot spot	Hot spot	Non-hot spot	Hot spot	
	Fraction of Site Area [4]:		0.26	0.74	
Chrysene	0.7577	1.3	0.197002	0.962	1.16
Di-n-butylphthalate	0.23	116.6124	0.0598	86.293176	86.4
Di-n-octylphthalate	0.3712	24	0.096512	17.76	17.9
Dibenzo(a,h)Anthracene	0.2771	0.12	0.072046	0.0888	0.16
Dibenzofuran	0.22	5.9	0.0572	4.366	4.42
Dimethylphthalate	0	0.53	0	0.3922	0.39
Fluoranthene	1.1294	4.1	0.293644	3.034	3.33
Fluorene	0.3	4	0.078	2.96	3.04
Indeno (1,2,3-cd)Pyrene	0.5181	13	0.134706	9.62	9.75
N-Nitrosodiphenylamine	0.3284	298.6483	0.085384	220.99974	221
Naphthalene	3.2598	2.2	0.847548	1.628	2.48
Phenanthrene	0.6342	34	0.164892	25.16	25.3
Phenol	0	31.0714	0	22.992836	23.0
Pyrene	0.8725	9.1	0.22685	6.734	6.96
bis(2-EthylHexyl)phthalate	37.0555	8303.3685	9.63443	6144.4927	6154
Pesticides/PCBs (mg/Kg)					
4,4'-DDD	0	0.0653	0	0.048322	0.048
4,4'-DDT	0.018	0.086	0.00468	0.06364	0.068
Aldrin	0	0.0439	0	0.032486	0.032
Alpha-BHC	0	0.0052	0	0.003848	0.0038
Alpha-Chlordane	0	0.2669	0	0.197506	0.20
Beta-BHC	0	0.045	0	0.0333	0.033
Delta-BHC	0	0.0371	0	0.027454	0.027
Endosulfan I	0.0081	0.0438	0.002106	0.032412	0.035
Endosulfan Sulfate	0	0.0765	0	0.05661	0.057
Endrin	0	0.0694	0	0.051356	0.051
Endrin Aldehyde	0.4023	0.1321	0.104598	0.097754	0.20
Endrin Ketone	0	0.0685	0	0.05069	0.051
Gamma-Chlordane	0.03	0.2691	0.0078	0.199134	0.21
Heptachlor	0	0.042	0	0.03108	0.031
Heptachlor Epoxide	0.005	0.0366	0.0013	0.027084	0.028
Methoxychlor	0	0.29	0	0.2146	0.21
Metals (mg/Kg)					
Aluminum	5839.4118	13582.062	1518.24707	10050.726	11569
Antimony	0	33.5297	0	24.811978	24.8
Arsenic	30.6265	35.7893	7.96289	26.484082	34.4
Barium	18.4647	31.6862	4.800822	23.447788	28.2
Beryllium	0	1.0864	0	0.803936	0.80
Cadmium	1.0765	1.2081	0.27989	0.893994	1.17
Calcium	1005.8824	1482.6738	261.529424	1097.1786	1359
Chromium	56.5882	1826.5595	14.712932	1351.654	1366

TABLE 64
SUMMARY SEDIMENT EXPOSURE POINT CONCENTRATIONS - FUTURE LAND USE

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	EPCs for Exposure Points [2]		Area-Weighted EPCs for Exposure Points [3]		EPC Total Site [5]
	Non-hot spot	Hot spot	Non-hot spot	Hot spot	
	Fraction of Site Area [4]:		0.26	0.74	
Cobalt	4.9765	6.8764	1.29389	5.088536	6.38
Copper	31.6059	36.0358	8.217534	26.666492	34.9
Iron	21166.4706	18142.531	5503.28236	13425.473	18929
Lead	16.0313	56.8788	4.168138	42.090312	46.3
Manganese	165.3824	130.5822	42.999424	96.630828	140
Mercury	0.0956	0.2891	0.024856	0.213934	0.24
Nickel	5.8029	12.5906	1.508754	9.317044	10.8
Potassium	518.2353	429.6605	134.741178	317.94877	453
Selenium	0.6994	0	0.181844	0	0.18
Silver	1.3	0.9364	0.338	0.692936	1.03
Sodium	91.3529	276.5571	23.751754	204.65225	228
Vanadium	16.0088	16.2636	4.162288	12.035064	16.2
Zinc	40.4382	109.7075	10.513932	81.18355	91.7
Inorganics (mg/Kg)					
Chloride	30.2353	166.6087	7.861178	123.29044	131
Nitrate as N		1.8218	0	1.348132	1.35
Nitrite as N		0.7001	0	0.518074	0.52
Nitrogen, Ammonia	38.5882	174.099	10.032932	128.83326	139
Sulfate as SO4	665.2941	1597.6765	172.976466	1182.2806	1355

Notes:
1 Selection of OHM of Concern for this medium are presented in Table 7.
2 EPCs for each exposure point are presented in the sediment exposure point concentration tables for future land use.
3 EPCs calculated by multiplying the EPC for the exposure point by the fractional site area of that exposure point.
4 Fractional site area represents the area of the exposure point divided by the area of the entire ditch (see sediment exposure point figure).
5 The final area-weighted EPC is the sum of the area-weighted EPCs for each exposure point.
"0" indicates that OHM was not detected in samples collected at exposure point. "Blank" indicates that OHM was not analyzed for or data were rejected.
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).
Non-hot spot is the portion of the on- and off-site ditch that is not a hot spot (EP35)
Hot spot is the portion of the on- and off-site ditch that is a hot spot (EP34)

TABLE 65
SUMMARY OF HUMAN HEALTH RISKS FOR CURRENT LAND USE

Olin Corporation
Wilmington, MA Facility

Receptor	Exposure Medium	Exposure Point	Exposure Pathway	Cancer Risk ELCR	Non-cancer risk HI
On-Property Worker	Surface Soil	Sulfate Landfill	Ingestion	1E-07	0.002
			Dermal Contact	3E-07	0.003
			Fugitive Dust Inhalation	2E-09	0.0008
			Total:	4E-07	0.006
	Surface Soil	Entire Site (excluding Sulfate Landfill)	Ingestion	3E-07	0.003
			Dermal Contact	1E-06	0.006
			Fugitive Dust Inhalation	9E-08	0.0009
			Total:	1E-06	0.01
	Surface Water	On-Site Ditches	Ingestion	3E-08	0.0005
			Dermal Contact	4E-08	0.01
			Total:	7E-08	0.01
	Sediment	On-Site Ditches	Ingestion	4E-07	0.004
			Dermal Contact	5E-07	0.005
			Total:	9E-07	0.009
	Groundwater	Building Air	Inhalation	2E-11	0.007
			Total	3E-11	0.007
	Groundwater	Butter's Row Treatment Plant	Ingestion	NA	0.05
			Total	NA	0.05
			Total Receptor Risk:	2E-06	0.09

TABLE 65
SUMMARY OF HUMAN HEALTH RISKS FOR CURRENT LAND USE

Olin Corporation
Wilmington, MA Facility

Receptor	Exposure Medium	Exposure Point	Exposure Pathway	Cancer Risk ELCR	Non-cancer risk HI
Utility Worker	Surface Soil	Entire Site (excluding Sulfate Landfill)	Ingestion	2E-09	0.02
			Dermal Contact	7E-10	0.003
			Fugitive Dust Inhalation	5E-11	0.004
			Total:	3E-09	0.03
	Subsurface Soil	Entire Site (excluding Sulfate Landfill)	Ingestion	9E-10	0.006
			Dermal Contact	3E-10	0.002
			Fugitive Dust Inhalation	3E-11	0.003
			Total:	1E-09	0.01
			Total Receptor Risk:	4E-09	0.04
Off-Property Worker	Groundwater	Process Water	Inhalation	NC	0.8
			Dermal Contact	5E-09	0.02
			Total:	5E-09	0.8
	Groundwater	Building Air	Inhalation	2E-11	0.007
			Total:	2E-11	0.007
	Groundwater	Butter's Row Treatment Plant	Ingestion	NA	0.05
			Total:	NA	0.05
			Total Receptor Risk:	5E-09	0.9

TABLE 65
SUMMARY OF HUMAN HEALTH RISKS FOR CURRENT LAND USE

Olin Corporation
Wilmington, MA Facility

Receptor	Exposure Medium	Exposure Point	Exposure Pathway	Cancer Risk ELCR	Non-cancer risk HI
Neighborhood Resident - East Side	Surface Water	Off-Site East Ditch	Ingestion	1E-08	0.0004
			Dermal Contact	5E-08	0.05
			Total:	6E-08	0.05
	Sediment	Off-Site East Ditch	Ingestion	5E-07	0.01
			Dermal Contact	8E-07	0.02
			Total:	1E-06	0.03
	Groundwater	Butter's Row Treatment Plant	Ingestion	NA	0.4
			Total:	NA	0.4
			Total Receptor Risk:	**1E-06**	**0.5**
Neighborhood Resident - West Side	Surface Water	Off-Site West Ditch	Ingestion	8E-11	0.0009
			Dermal Contact	1E-09	0.01
			Total:	1E-09	0.01
	Sediment	Off-Site West Ditch	Ingestion	5E-08	0.006
			Dermal Contact	1E-07	0.03
			Total:	2E-07	0.04
	Groundwater	Butter's Row Treatment Plant	Ingestion	NA	0.4
			Total:	NA	0.4
			Total Receptor Risk:	**2E-07**	**0.4**

Notes:
Risk calculation spreadsheets for surface soil presented in Attachment 6.
Risk calculation spreadsheets for subsurface soil presented in Attachment 7.
Risk calculation spreadsheets for groundwater presented in Attachment 8.

TABLE 65
SUMMARY OF HUMAN HEALTH RISKS FOR CURRENT LAND USE

Olin Corporation
Wilmington, MA Facility

Receptor	Exposure Medium	Exposure Point	Exposure Pathway	Cancer Risk ELCR	Non-cancer risk HI

Risk calculation spreadsheets for surface water presented in Attachment 9.
Risk calculation spreadsheets for sediment presented in Attachment 10.
HI = Hazard index
ELCR = Excess lifetime cancer risk
Total Receptor Risk is the sum of risks for each exposure medium to which the receptor is exposed.

TABLE 66
SUMMARY OF HUMAN HEALTH RISKS FOR FUTURE LAND USE

Olin Corporation
Wilmington, MA Facility

Receptor	Exposure Medium	Exposure Point	Exposure Pathway	Cancer Risk ELCR	Non-cancer risk HI
On-Property Worker (full-time, long-term)	Surface Soil	Sulfate Landfill	Ingestion	1E-06	0.02
			Dermal Contact	2E-06	0.03
			Fugitive Dust Inhalation	2E-08	0.007
			Total:	3E-06	0.06
	Surface Soil	Entire Site (excluding Sulfate Landfill)	Ingestion	2E-06	0.02
			Dermal Contact	5E-06	0.04
			Fugitive Dust Inhalation	3E-07	0.03
			Total:	7E-06	0.09
	Surface Water	On-Site Ditches	Ingestion	3E-08	0.0005
			Dermal Contact	4E-08	0.01
			Total:	7E-08	0.01
	Sediment	On-Site Ditches	Ingestion	4E-07	0.004
			Dermal Contact	5E-07	0.005
			Total:	9E-07	0.009
	Groundwater	Building Air	Inhalation	3E-09	0.1
			Total	3E-09	0.1
	Groundwater	Butter's Row Treatment Plant	Ingestion	NA	0.07
			Total	NA	0.07
			Total Receptor Risk:	1E-05	0.3

TABLE 66
SUMMARY OF HUMAN HEALTH RISKS FOR FUTURE LAND USE

Olin Corporation
Wilmington, MA Facility

Receptor	Exposure Medium	Exposure Point	Exposure Pathway	Cancer Risk ELCR	Non-cancer risk HI
Off-Property Worker	Groundwater	Process Water	Inhalation	NC	0.8
			Dermal Contact	5E-09	0.02
			Total:	5E-09	0.8
	Groundwater	Building Air	Inhalation	3E-09	0.1
			Total:	3E-09	0.1
	Groundwater	Butter's Row Treatment Plant	Ingestion	NA	0.07
			Total	NA	0.07
			Total Receptor Risk:	8E-09	1
Neighborhood Resident	Surface Soil	Sulfate Landfill	Ingestion	7E-08	0.002
			Dermal Contact	1E-07	0.003
			Total:	2E-07	0.005
	Surface Soil	Entire Site (excluding Sulfate Landfill)	Ingestion	1E-07	0.003
			Dermal Contact	4E-07	0.006
			Total:	5E-07	0.009
	Surface Water	All Ditches	Ingestion	1E-08	0.0006
			Dermal Contact	5E-08	0.04
			Total:	6E-08	0.04
	Sediment	All Ditches	Ingestion	4E-07	0.01
			Dermal Contact	8E-07	0.02
			Total:	1E-06	0.03

TABLE 66
SUMMARY OF HUMAN HEALTH RISKS FOR FUTURE LAND USE

Olin Corporation
Wilmington, MA Facility

Receptor	Exposure Medium	Exposure Point	Exposure Pathway	Cancer Risk ELCR	Non-cancer risk HI
	Groundwater	Butter's Row Treatment Plant	Ingestion	NA	0.5
			Total	NA	0.5
			Total Receptor Risk:	**2E-06**	**0.6**
Construction Worker	Surface Soil	Entire Site (excluding Sulfate Landfill)	Ingestion	4E-08	0.06
			Dermal Contact	2E-08	0.01
			Fugitive Dust Inhalation	1E-09	0.02
			Total:	6E-08	0.09
	Subsurface Soil	Entire Site (excluding Sulfate Landfill)	Ingestion	2E-08	0.03
			Dermal Contact	8E-09	0.008
			Fugitive Dust Inhalation	6E-10	0.01
			Total:	3E-08	0.05
			Total Receptor Risk:	**9E-08**	**0.1**
Utility Worker	Surface Soil	Entire Site (excluding Sulfate Landfill)	Ingestion	2E-09	0.02
			Dermal Contact	7E-10	0.003
			Fugitive Dust Inhalation	5E-11	0.004
			Total:	3E-09	0.03
	Subsurface Soil	Entire Site (excluding Sulfate Landfill)	Ingestion	9E-10	0.006
			Dermal Contact	3E-10	0.002
			Fugitive Dust Inhalation	3E-11	0.003
			Total:	1E-09	0.01
			Total Receptor Risk:	**4E-09**	**0.04**

Notes:

TABLE 66
SUMMARY OF HUMAN HEALTH RISKS FOR FUTURE LAND USE

Olin Corporation
Wilmington, MA Facility

Receptor	Exposure Medium	Exposure Point	Exposure Pathway	Cancer Risk ELCR	Non-cancer risk HI

Risk calculation spreadsheets for surface soil presented in Attachment 6.
Risk calculation spreadsheets for subsurface soil presented in Attachment 7.
Risk calculation spreadsheets for groundwater presented in Attachment 8, risks shown here for future conditions are based on most conservative realistic modeling scenario.
Risk calculation spreadsheets for surface water presented in Attachment 9.
Risk calculation spreadsheets for sediment presented in Attachment 10.
HI = Hazard index
ELCR = Excess lifetime cancer risk
Total Receptor Risk is the sum of risks for each exposure medium to which the receptor is exposed.

TABLE 67
COMPARISON OF ZONE II GROUNDWATER EPCs TO UCLs AND MCLs
PLANT B HOT SPOT

Olin Corporation
Wilmington, MA Facility

	Site Data/Concentration [2]										
OHM of Concern[1]	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Groundwater EPC [3]	UCL [4]	EPC Exceeds UCL?	MCL [5]	EPC Exceeds MCL?
VOCs (mg/L)											
2,4,4-Trimethyl-1-pentene	0.01 :	0.01	7 / 8	0.007	0.56	0.2161	0.56	NA	NA	NA	NA
2,4,4-Trimethyl-2-Pentene	0.01 :	0.01	7 / 8	0.002	0.16	0.058	0.16	NA	NA	NA	NA
2-Hexanone	0.01 :	0.08	1 / 8	2	2	0.2619	2	NA	NA	NA	NA
Acetone	0.01 :	0.1	3 / 8	0.026	0.66	0.1057	0.66	100	No	3 G	No
Ethylbenzene	0.005 :	0.03	1 / 8	0.047	0.047	0.0106	0.047	100	No	0.7	No
Methylene Chloride	0.005 :	0.05	1 / 8	0.006	0.006	0.0098	0.006	100	No	0.005	Yes
Toluene	0.005 :	0.05	2 / 8	0.001	0.018	0.008	0.018	100	No	1	No
Xylenes, Total	0.005 :	0.005	3 / 8	0.008	0.039	0.0123	0.039	100	No	10	No
SVOCS (mg/L)											
1,2-Dichlorobenzene	0.01 :	0.2	1 / 8	0.001	0.001	0.0208	0.001	100	No	0.6	No
1,4-Dichlorobenzene	0.01 :	0.2	1 / 8	0.002	0.002	0.0209	0.002	40	No	0.005	No
4-Chloroaniline	0.01 :	0.2	1 / 8	0.01	0.01	0.0219	0.01	100	No	NA	NA
4-Methylphenol(p-Cresol)	0.01 :	0.2	2 / 8	0.005	0.012	0.019	0.012	NA	NA	NA	NA
4-Nitrophenol	0.025 :	1	2 / 7	0.006	0.006	0.091	0.006	NA	NA	NA	NA
Benzoic Acid	0.05 :	1	1 / 7	0.003	0.003	0.0933	0.003	NA	NA	NA	NA
Di-n-butylphthalate	0.01 :	0.06	3 / 8	0.001	0.006	0.0079	0.006	NA	NA	NA	NA
Di-n-octylphthalate	0.01 :	0.2	1 / 8	6.4	6.4	0.8175	6.4	NA	NA	NA	NA
Dibenzofuran	0.01 :	0.2	2 / 8	0.002	0.002	0.0205	0.002	NA	NA	NA	NA
Diethylphthalate	0.01 :	0.06	1 / 8	0.011	0.011	0.0101	0.011	60	No	NA	NA
Fluorene	0.01 :	0.2	1 / 8	0.019	0.019	0.0199	0.019	1	No	NA	NA
Indeno (1,2,3-cd) pyrene	0.01 :	0.2	1 / 8	1.4	1.4	0.1925	1.4	0.0005	Yes	NA	NA
N-Nitrosodiphenylamine	0 :	0	8 / 8	0.005	14	2.1063	14	NA	NA	NA	NA
Naphthalene	0.01 :	0.2	1 / 8	0.046	0.046	0.0233	0.046	20	No	NA	NA
Phenol	0.01 :	0.2	4 / 7	0.001	0.005	0.0181	0.005	100	No	NA	NA
bis(2-EthylHexyl)phthalate	0.01 :	0.01	5 / 8	0.002	190	23.7886	190	0.7	Yes	0.006	Yes
Pesticides/PCBs (mg/L)											
Aldrin	0.00005 :	0.0007	2 / 8	0.000069	0.000077	0.000078	0.0001	0.009	No	NA	NA
Gamma-BHC (Lindane)	0.00005 :	0.0007	1 / 7	0.000099	0.000099	0.000082	0.0001	0.05	No	0.002	No
Heptachlor epoxide	0.00005 :	0.0007	1 / 8	0.000013	0.000013	0.000061	0.0001	0.01	No	0.0004	No

TABLE 67
COMPARISON OF ZONE II GROUNDWATER EPCs TO UCLs AND MCLs
PLANT B HOT SPOT

Olin Corporation
Wilmington, MA Facility

	Site Data/Concentration [2]								EPC			EPC
OHM of Concern[1]	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Groundwater EPC [3]	UCL [4]	Exceeds UCL?	MCL [5]		Exceeds MCL?
Metals (mg/L)												
Aluminum	0 :	0	1 / 1	0.36	0.36	0.36	0.36	NA	NA	NA		NA
Arsenic	0 :	0	1 / 1	0.035	0.035	0.035	0.035	4	No	0.05		No
Barium	0 :	0	1 / 1	0.019	0.019	0.019	0.019	100	No	2		No
Calcium	0 :	0	1 / 1	14	14	14	14	NA	NA	NA		NA
Chromium	0.01 :	0.015	1 / 6	0.018	0.018	0.0084	0.018	1	No	0.1		No
Copper	0 :	0	1 / 1	0.033	0.033	0.033	0.033	NA	NA	1.3		No
Iron	0 :	0	1 / 1	17	17	17	17	NA	NA	0.3	S	No
Magnesium	0 :	0	1 / 1	2.9	2.9	2.9	2.9	NA	NA	NA		NA
Manganese	0 :	0	1 / 1	0.53	0.53	0.53	0.53	NA	NA	0.05	S	No
Mercury	0 :	0	1 / 1	0.0003	0.0003	0.0003	0.0003	0.02	No	0.002		No
Potassium	0 :	0	1 / 1	2.7	2.7	2.7	2.7	NA	NA	20	G	No
Sodium	0 :	0	1 / 1	25	25	25	25	NA	NA	NA		NA
Zinc	0 :	0	1 / 1	0.43	0.43	0.43	0.43	20	No	5	S	No
Inorganics (mg/L)												
Chloride	0 :	0	11 / 11	5.1	60	34	60	NA	NA	250	S	No
Nitrogen, Ammonia	0 :	0	10 / 10	1.7	380	87.659	380	NA	NA	NA		NA
Sulfate as SO4	0 :	0	10 / 10	2.5	180	47.61	180	NA	NA	250	S	No

TABLE 67
COMPARISON OF ZONE II GROUNDWATER EPCs TO UCLs AND MCLs
PLANT B HOT SPOT

Olin Corporation
Wilmington, MA Facility

	Site Data/Concentration [2]										
OHM of Concern[1]	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Groundwater EPC [3]	UCL [4]	EPC Exceeds UCL?	MCL [5]	EPC Exceeds MCL?

Notes:

1 Selection of OHM of Concern for this medium is presented in Table 4.

2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.

3 The EPC is the maximum detected concentration.

4 UCL = Upper Concentration Limit in Soil (310 CMR 40.0996(5); 4/5/96)

5 MCL = Maximum Contaminant Level (Drinking Water Standards & Guidelines for Chemicals in Massachusetts Drinking Water; May 1996)

G= Massachusetts Drinking Water Guideline Value

S= Massachusetts Secondary MCL

EPC = Exposure Point Concentration

OHM = Oil or Hazardous Material

SQL = Sample Quantitation Limit

MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 68
COMPARISON OF ZONE II GROUNDWATER EPCs TO UCLs AND MCLs
ZONE II GROUNDWATER (INCLUDING DENSE LAYER HOT SPOT)

Olin Corporation
Wilmington, MA Facility

OHM of Concern[1]	Site Data/Concentration[2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Groundwater EPC[3]	UCL[4]	EPC Exceeds UCL?	MCL[5]	EPC Exceeds MCL?
VOCs (mg/L)											
1,2-Dichloroethane	0.0002 :	0.02	8 / 35	0.0001	0.02	0.0035	0.02	100	No	0.005	Yes
cis-1,2-Dichloroethene	0 :	0	2 / 2	0.0052	0.033	0.0191	0.033	100	No	0.07	No
trans-1,2-Dichloroethene	0.0002 :	0.0002	1 / 2	0.0003	0.0003	0.0002	0.0003	100	No	0.1	No
1,2-Dichloroethene(total)	0.005 :	0.005	11 / 33	0.002	0.43	0.0366	0.43	NA	NA	0.07 Su	Yes
2,4,4-Trimethyl-1-pentene	0.005 :	0.02	7 / 34	0.002	0.012	0.005	0.012	NA	NA	NA	NA
2,4,4-Trimethyl-2-Pentene	0.005 :	0.02	5 / 34	0.002	0.006	0.0044	0.006	NA	NA	NA	NA
2-Butanone (MEK)	0.01 :	0.04	2 / 33	0.011	0.027	0.0083	0.027	100	No	0.35 G	No
2-Hexanone	0.01 :	0.015	3 / 33	0.057	0.12	0.0148	0.12	NA	NA	NA	NA
4-Methyl-2-Pentanone (MIBK)	0.01 :	0.04	3 / 33	0.003	0.003	0.0072	0.003	100	No	0.35 G	No
Acetone	0.01 :	0.04	9 / 33	0.004	0.37	0.0288	0.37	100	No	3 G	No
Benzene	0.0004 :	0.02	11 / 35	0.0001	0.011	0.003	0.011	70	No	0.005	Yes
Bromodichloromethane	0.0002 :	0.02	1 / 35	0.002	0.002	0.0029	0.002	100	No	NA	NA
Bromoform	0.005 :	0.02	2 / 33	0.004	0.014	0.0034	0.014	100	No	NA	NA
Carbon Disulfide	0.005 :	0.02	4 / 33	0.001	0.015	0.0051	0.015	NA	NA	NA	NA
Chlorobenzene	0.0002 :	0.02	3 / 35	0.0002	0.001	0.0028	0.001	10	No	0.1	No
Chloroform	0.0003 :	0.02	6 / 35	0.004	0.079	0.009	0.079	100	No	0.005	Yes
Dibromochloromethane	0.0002 :	0.02	1 / 35	0.003	0.003	0.0029	0.003	100	No	NA	NA
Ethylbenzene	0.005 :	0.05	6 / 33	0.002	0.007	0.004	0.007	100	No	0.7	No
Methylene Chloride	0.005 :	0.033	10 / 35	0.0009	0.02	0.005	0.02	100	No	0.005	Yes
Tetrachloroethene (PCE)	0.0002 :	0.02	4 / 34	0.001	0.004	0.0028	0.004	50	No	0.005	No
Toluene	0.005 :	0.02	9 / 33	0.001	0.17	0.0219	0.17	100	No	1	No
Trichloroethene (TCE)	0.005 :	0.02	14 / 35	0.0009	0.46	0.0316	0.46	100	No	0.005	Yes
Vinyl Chloride	0.0004 :	0.04	3 / 35	0.0002	0.013	0.0059	0.013	0.6	No	0.002	Yes
Xylenes, Total	0.005 :	0.02	4 / 33	0.004	0.017	0.0039	0.017	100	No	10	No
SVOCs (mg/L)											
1,2-Dichlorobenzene	0.01 :	0.01	3 / 32	0.0003	0.001	0.0046	0.001	100	No	0.6	No
1,4-Dichlorobenzene	0.01 :	0.01	3 / 32	0.001	0.002	0.0047	0.002	40	No	0.005	No
2,4-Dichlorophenol	0.01 :	0.01	4 / 32	0.001	0.003	0.0046	0.003	40	No	NA	NA
2-Methylphenol (o-Cresol)	0.01 :	0.01	4 / 32	0.002	0.017	0.0054	0.017	NA	NA	NA	NA
2-Nitrophenol	0.01 :	0.01	2 / 32	0.032	0.045	0.0071	0.045	NA	NA	NA	NA
4-Methylphenol(p-Cresol)	0.01 :	0.01	4 / 32	0.002	0.051	0.0081	0.051	NA	NA	NA	NA
4-Nitrophenol	0.025 :	0.05	4 / 32	0.004	0.11	0.0216	0.11	NA	NA	NA	NA

TABLE 68
COMPARISON OF ZONE II GROUNDWATER EPCs TO UCLs AND MCLs
ZONE II GROUNDWATER (INCLUDING DENSE LAYER HOT SPOT)

Olin Corporation
Wilmington, MA Facility

	Site Data/Concentration [2]											
OHM of Concern [1]	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Groundwater EPC [3]	UCL [4]	EPC Exceeds UCL?	MCL [5]		EPC Exceeds MCL?
Benzoic Acid	0.05 :	0.05	3 / 32	0.003	0.041	0.0249	0.041	NA	NA	NA		NA
Benzyl Alcohol	0.01 :	0.01	4 / 32	0.002	0.006	0.0048	0.006	NA	NA	NA		NA
Di-n-butylphthalate	0.01 :	0.01	12 / 33	0.0003	0.0009	0.0034	0.0009	NA	NA	NA		NA
Diethylphthalate	0.007 :	0.01	8 / 35	0.0002	0.005	0.0041	0.005	60	No	NA		NA
N-Nitrosodiphenylamine	0.01 :	0.01	4 / 33	0.001	0.011	0.005	0.011	NA	NA	NA		NA
Naphthalene	0.01 :	0.01	7 / 34	0.0002	0.015	0.005	0.015	20	No	NA		NA
Phenol	0.01 :	0.01	5 / 34	0.005	1.2	0.0674	1.2	100	No	NA		NA
bis(2-EthylHexyl)phthalate	0.01 :	0.01	10 / 34	0.0002	0.012	0.0043	0.012	0.7	No	0.006		Yes
Pesticides/PCBs (mg/L)												
Alpha-BHC	0.00005 :	0.0005	3 / 20	0.000059	0.000073	0.000045	0.000073	NA	NA	NA		NA
Gamma-BHC	0.00005	0.0006	1 / 21	0.00011	0.00011	0.000042	0.00011	0.008	No	0.0002		No
Metals (mg/L)												
Aluminum	0.1 :	0.1	3 / 8	0.63	990	127.985	990	NA	NA	0.05	S	Yes
Arsenic	0.005 :	2.5	4 / 8	0.005	0.084	0.1706	0.084	4	No	0.05		Yes
Barium	0.05 :	0.05	7 / 8	0.006	0.28	0.0513	0.28	100	No	2		No
Calcium	0 :	0	7 / 7	5.1	470	162.3	470	NA	NA	NA		NA
Chromium	0.01 :	0.03	5 / 29	0.023	790	27.4238	790	1	Yes	0.1		Yes
Cobalt	0 :	0	1 / 1	0.089	0.089	0.089	0.089	NA	NA	NA		NA
Copper	0.025 :	0.025	2 / 3	0.027	0.23	0.0898	0.23	NA	NA	1.3		No
Iron	0.054 :	0.054	7 / 8	0.04	1800	244.5334	1800	NA	NA	0.3	S	Yes
Lead	0.005 :	0.005	4 / 8	0.006	0.1	0.0218	0.1	0.3	No	0.015		Yes
Magnesium	0 :	0	7 / 7	0.92	750	172.3814	750	NA	NA	NA		NA
Manganese	0 :	0	8 / 8	0.015	150	28.7094	150	NA	NA	0.05	S	Yes
Nickel	0 :	0	1 / 1	0.13	0.13	0.13	0.13	1	No	0.1	G	Yes
Potassium	0 :	0	6 / 6	0.74	110	31.1233	110	NA	NA	NA		NA
Sodium	0 :	0	9 / 9	12	10000	1500.3667	10000	NA	NA	20	G	Yes
Vanadium	0 :	0	1 / 1	0.15	0.15	0.15	0.15	20	No	NA		NA
Zinc	0 :	0	3 / 3	0.028	22	7.3543	22	20	Yes	5	S	Yes
Inorganics (mg/L)												
Chloride	2 :	3	55 / 57	3.6	12000	1238.7	12000	NA	NA	250	S	Yes
Nitrate as N	0.05 :	0.2	3 / 7	2.1	24	5.7536	24	NA	NA	10		Yes
Nitrite as N	0.05 :	0.05	2 / 6	0.05	0.17	0.0533	0.17	NA	NA	1		No
Nitrogen, Ammonia	0.04 :	0.1	57 / 62	0.12	4100	184.8082	4100	NA	NA	NA		NA

TABLE 68
COMPARISON OF ZONE II GROUNDWATER EPCs TO UCLs AND MCLs
ZONE II GROUNDWATER (INCLUDING DENSE LAYER HOT SPOT)

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Groundwater EPC [3]	UCL [4]	EPC Exceeds UCL?	MCL [5]		EPC Exceeds MCL?
Sulfate as SO4	10 :	10	57 / 58	4.4	48000	4671.4931	48000	NA	NA	250	S	Yes

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 4.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
3 The EPC is the maximum detected concentration.
4 UCL = Upper Concentration Limit in Groundwater (310 CMR 40.0996(5); 4/5/96)
5 MCL = Maximum Contaminant Level (Drinking Water Standards & Guidelines for Chemicals in Massachusetts Drinking Water; May 1996)
SU = surrogate: MCL for cis-1,2-Dichloroethene used as surrogate.
G= Massachusetts Drinking Water Guideline Value
S= Massachusetts Secondary MCL
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 69
COMPARISON OF ZONE II GROUNDWATER EPCs TO UCLs AND MCLs
TOWN WELLS - FUTURE CONDITIONS
SCENARIO: ALL WELLS PUMPING - WET SEASON
Olin Corporation
Wilmington, MA Facility

SCENARIO WITH WELL GW-83-d

Well	Flow Conditions		OHM / Groundwater EPC (mg/L)[1]									
Well	5-year average flow (gpm)	Relative Flow	Chloride	Ammonia	Sodium	Sulfate	Aluminum	Iron	Calcium	Magnesium	Manganese	Total Dissolved Solids
Butter's Row #1	190.2	0.2	114	9.7	77	192	0.32	14.7	37	10	1.11	465
Butters Row #2	286.7	0.3	66	0.38	33	43	0.2	5.5	21	4.9	0.25	316
Chestnut Street #1	173.3	0.18	284	65	309	849	1.4	57	40	22	3	1584
Chestnut #2/1A	263.1	0.28	57	0.63	33	30	0.2	1.1	15	4.8	0.02	208
Town Park	30.2	0.03	94	0.42	39	30	0.2	0.99	17	4.5	0.47	233
TOTAL	943.5											
	1.35864 mgd											
Incoming OHM at BRTP (est; mg/L) [2]			112.5	13.94	91.3	213.4	0.438	15.2	25.6	8.9	0.86	538
OHM in finished water (est; mg/L) [2]			112.5	NP [3]	91.3	234.4	NE	<0.1	NE	NE	0.034	NE
		MCL	250 S	NA	20 G	250 S	0.05 S	0.3 S	NA	NA	0.05 S	500 S
		UCL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Exeedance - incoming		No	NA	Yes	No	Yes	Yes	NA	NA	Yes	Yes
	Exceedance - finished		No	NA	Yes	No	NE	No	NE	NE	No	NE

TABLE 69
COMPARISON OF ZONE II GROUNDWATER EPCs TO UCLs AND MCLs
TOWN WELLS - FUTURE CONDITIONS
SCENARIO: ALL WELLS PUMPING - WET SEASON
Olin Corporation
Wilmington, MA Facility

SCENARIO WITHOUT WELL GW-83-d

Well	Flow Conditions		OHM / Groundwater EPC (mg/L)[1]									
Well	5-year average flow (gpm)	Relative Flow	Chloride	Ammonia	Sodium	Sulfate	Aluminum	Iron	Calcium	Magnesium	Manganese	Total Dissolved Solids
Butter's Row #1	190.2	0.2	93	3.3	49	112	0.19	9.1	35	8.3	0.9	328
Butters Row #2	286.7	0.3	66	0.38	33	43	0.2	5.5	21	4.9	0.25	316
Chestnut Street #1	173.3	0.18	81	4.3	41	87	0.19	5	27	6	1	288
Chestnut #2/1A	263.1	0.28	57	0.63	33	30	0.2	1.1	15	4.8	0.02	208
Town Park	30.2	0.03	94	0.42	39	30	0.2	0.99	17	4.5	0.47	233
TOTAL	943.5											
	1.35864 mgd											
Incoming OHM at BRTP (est; mg/L) [2]			71.8	1.74	37.5	60.3	0.19	4.7	22.9	5.7	0.45	277
OHM in finished water (est; mg/L) [2]			71.8	NP [3]	37.5	81.3	NE	<0.1	NE	NE	0.034	NE
	MCL		250 S	NA	20 G	250 S	0.05 S	0.3 S	NA	NA	0.05 S	500 S
	UCL		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Exeedance - incoming		No	NA	Yes	No	Yes	Yes	NA	NA	Yes	No
	Exceedance - finished		No	NA	Yes	No	NE	No	NE	NE	No	NE

Notes:

1 OHM are those that were modeled, as described in text.

2 Concentrations calculated as *described in text.*

All data represent dissolved concentrations except manganese, for which the data presented represent total concentrations.

3 No ammonia as ammonium ion would be expected in water containing greater than 0.1 mg/L free residual chlorine. The presence of free residual chlorine indicates that any ammonia has been oxidized. At Butter's Row, maintenance of free residual chlorine is required for disinfection purposes.

EPC = Exposure Point Concentration

OHM = Oil or Hazardous Material

gpm = gallon per minute

mgd = million gallons per day

TABLE 69
COMPARISON OF ZONE II GROUNDWATER EPCs TO UCLs AND MCLs
TOWN WELLS - FUTURE CONDITIONS
SCENARIO: ALL WELLS PUMPING - WET SEASON
Olin Corporation
Wilmington, MA Facility

BRTP = Butters Row Treatment Plant
NE = Not Evaluated
UCL = Upper Concentration Limit in Groundwater (310 CMR 40.0996(5); 4/5/96)
MCL = Maximum Contaminant Level (Drinking Water Standards & Guidelines for Chemicals in Massachusetts Drinking Water; May 1996)
G= Massachusetts Drinking Water Guideline Value
S= Massachusetts Secondary MCL
NP = Not Present

TABLE 70
COMPARISON OF ZONE II GROUNDWATER EPCs TO UCLs AND MCLs
TOWN WELLS - FUTURE CONDITIONS
SCENARIO: ALL WELLS PUMPING - DRY SEASON
Olin Corporation
Wilmington, MA Facility

Well	Flow Conditions		OHM / Groundwater EPC (mg/L)[1]									
Well	5-year average flow (gpm)	Relative Flow	Chloride	Ammonia	Sodium	Sulfate	Aluminum	Iron	Calcium	Magnesium	Manganese	Total Dissolved Solids
Butter's Row #1	190.2	0.2	89	2.6	45	95	0.2	9.1	33	7.5	0.84	303
Butters Row #2	286.7	0.3	66	0.38	33	43	0.2	5.5	21	4.9	0.25	316
Chestnut Street #1	173.3	0.18	134	15	67	262	0.2	6.4	52	13	2.1	588
Chestnut #2/1A	263.1	0.28	57	0.63	33	30	0.2	1.1	15	4.8	0.02	208
Town Park	30.2	0.03	94	0.42	39	30	0.2	0.99	17	4.5	0.47	233
TOTAL	943.5											
	1.35864 mgd											
Incoming OHM at BRTP (est; mg/L) [2]			80.5	3.52	41.4	88.4	0.198	5.0	27.0	6.8	0.64	326
OHM in finished water (est; mg/L) [2]			80.5	NP [3]	41.4	109.4	NE	<0.1	NE	NE	0.034	NE
	MCL		250 S	NA	20 G	250 S	0.05 S	0.3 S	NA	NA	0.05 S	500 S
	UCL		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Exeedance - incoming		No	NA	Yes	No	Yes	Yes	NA	NA	Yes	No
	Exceedance - finished		No	NA	Yes	No	NE	No	NE	NE	No	NE

Notes:

1 OHM are those that were modeled, as described in text.

2 Concentrations calculated as described in text.

All data represent dissolved concentrations except manganese, for which the data presented represent total concentrations.

3 No ammonia as ammonium ion would be expected in water containing greater than 0.1 mg/L free residual chlorine. The presence of free residual chlorine indicates that any ammonia has been oxidized. At Butter's Row, maintenance of free residual chlorine is required for disinfection purposes.

EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
gpm = gallon per minute
mgd = million gallons per day
BRTP = Butters Row Treatment Plant
NE = Not Evaluated
UCL = Upper Concentration Limit in Groundwater (310 CMR 40.0996(5); 4/5/96)
MCL = Maximum Contaminant Level (Drinking Water Standards & Guidelines for Chemicals in Massachusetts Drinking Water; May 1996)
G= Massachusetts Drinking Water Guideline Value
S= Massachusetts Secondary MCL
NP = Not Present

TABLE 71
COMPARISON OF ZONE II GROUNDWATER EPCs TO UCLs AND MCLs
TOWN WELLS - FUTURE CONDITIONS
SCENARIO: BUTTERS ROW #1 PUMPING - WET SEASON
Olin Corporation
Wilmington, MA Facility

Well	Flow Conditions		OHM / Groundwater EPC (mg/L)[1]									
Well	5-year average flow (gpm)	Relative Flow	Chloride	Ammonia	Sodium	Sulfate	Aluminum	Iron	Calcium	Magnesium	Manganese	Total Dissolved Solids
Butter's Row #1	190.2	1	90	2.5	46	92	0.19	7	32	7.4	0.79	309
Butters Row #2	286.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chestnut Street #1	173.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chestnut #2/1A	263.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Town Park	30.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	943.5 1.35864 mgd											
Incoming OHM at BRTP (est; mg/L) [2]			90.0	2.50	46.0	92.0	0.190	7.0	32.0	7.4	0.79	309.0
OHM in finished water (est; mg/L) [2]			90.0	NP [3]	46.0	113.0	NE	<0.1	NE	NE	0.034	NE
		MCL	250 S	NA	20 G	250 S	0.05 S	0.3 S	NA	NA	0.05 S	500 S
		UCL	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Exeedance - incoming	No	NA	Yes	No	Yes	Yes	NA	NA	Yes	No
		Exceedance - finished	No	NA	Yes	No	NE	No	NE	NE	No	NE

Notes:

[1] OHM are those that were modeled, as described in text.

[2] Concentrations calculated as described in text.

All data represent dissolved concentrations except manganese, for which the data presented represent total concentrations.

3 No ammonia as ammonium ion would be expected in water containing greater than 0.1 mg/L free residual chlorine. The presence of free residual chlorine indicates that any ammonia has been oxidized. At Butter's Row, maintenance of free residual chlorine is required for disinfection purposes.

EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
gpm = gallon per minute
mgd = million gallons per day
BRTP = Butters Row Treatment Plant
NA = Not Applicable
NE = Not Evaluated
UCL = Upper Concentration Limit in Groundwater (310 CMR 40.0996(5); 4/5/96)
MCL = Maximum Contaminant Level (Drinking Water Standards & Guidelines for Chemicals in Massachusetts Drinking Water; May 1996)
G= Massachusetts Drinking Water Guideline Value
S= Massachusetts Secondary MCL
NP = Not Present

TABLE 72
COMPARISON OF ZONE II GROUNDWATER EPCs TO UCLs AND MCLs
TOWN WELLS - FUTURE CONDITIONS
SCENARIO: BUTTERS ROW #1 PUMPING - DRY SEASON
Olin Corporation
Wilmington, MA Facility

Well	Flow Conditions		OHM / Groundwater EPC (mg/L)[1]									
Well	5-year average flow (gpm)	Relative Flow	Chloride	Ammonia	Sodium	Sulfate	Aluminum	Iron	Calcium	Magnesium	Manganese	Total Dissolved Solids
Butter's Row #1	190.2	1	79	1.5	40	61	0.2	6.1	25	5.9	0.55	268
Butters Row #2	286.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chestnut Street #1	173.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chestnut #2/1A	263.1	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Town Park	30.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL	943.5											
	1.35864 mgd											
Incoming OHM at BRTP (est; mg/L)[2]			79.0	1.50	40.0	61.0	0.200	6.1	25.0	5.9	0.55	268.0
OHM in finished water (est; mg/L)[2]			79.0	NP[3]	40.0	82.0	NE	<0.1	NE	NE	0.034	NE
	MCL		250 S	NA	20 G	250 S	0.05 S	0.3 S	NA	NA	0.05 S	500 S
	UCL		NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Exeedance - incoming		No	NA	Yes	No	Yes	Yes	NA	NA	Yes	No
	Exceedance - finished		No	NA	Yes	No	NE	No	NE	NE	No	NE

Notes:
1 OHM are those that were modeled, as described in text.
2 Concentrations calculated as described in text.
All data represent dissolved concentrations except manganese, for which the data presented represent total concentrations.
3 No ammonia as ammonium ion would be expected in water containing greater than 0.1 mg/L free residual chlorine. The presence of free residual chlorine indicates that any ammonia has been oxidized. At Butter's Row, maintenance of free residual chlorine is required for disinfection purposes.
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
gpm = gallon per minute
mgd = million gallons per day
BRTP = Butters Row Treatment Plant
NA = Not Applicable
NE = Not Evaluated
UCL = Upper Concentration Limit in Groundwater (310 CMR 40.0996(5); 4/5/96)
MCL = Maximum Contaminant Level (Drinking Water Standards & Guidelines for Chemicals in Massachusetts Drinking Water; May 1996)
G= Massachusetts Drinking Water Guideline Value
S= Massachusetts Secondary MCL
NP = Not Present

TABLE 73
COMPARISON OF SURFACE SOIL EPCs TO UCLs - AREA 8 HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]	UCL [4]	EPC Exceeds UCL?
VOCs (mg/Kg)									
1,1,1-Trichloroethane	0.006 :	0.014	10 / 22	0.002	0.016	0.0067	0.0067	5000	No
2,4,4-Trimethyl-1-pentene	0.005 :	0.013	5 / 22	0.0008	0.014	0.0043	0.0043	NA	NA
2-Butanone (MEK)	0.011 :	0.028	2 / 22	0.001	0.004	0.0071	0.004	10000	No
Acetone	0.013 :	0.021	20 / 22	0.006	0.061	0.0208	0.0208	10000	No
Methylene Chloride	0.005 :	0.014	6 / 22	0.004	0.036	0.0054	0.0054	7000	No
Toluene	0.005 :	0.013	3 / 22	0.0006	0.005	0.0033	0.0033	10000	No
SVOCs (mg/Kg)									
2-Methylnaphthalene	0.38 :	4.3	2 / 21	0.007	560	27.0453	27.0453	10000	No
2-Methylphenol (o-Cresol)	0.39 :	160	2 / 21	0.02	0.049	4.1821	0.049	NA	NA
Acenaphthene	0.38 :	4.3	1 / 21	170	170	8.4841	8.4841	10000	No
Acenaphthylene	0.38 :	4.3	3 / 21	0.02	420	20.3667	20.3667	10000	No
Anthracene	0.39 :	4.3	6 / 21	0.01	290	14.1153	14.1153	10000	No
Benzo(a)Anthracene	0.39 :	4.3	5 / 21	0.015	140	7.0161	7.0161	100	No
Benzo(a)Pyrene	0.38 :	4.3	3 / 21	0.034	100	5.1281	5.1281	100	No
Benzo(b)Fluoranthene	0.38 :	4.3	4 / 21	0.044	44	2.4527	2.4527	100	No
Benzo(g,h,i)Perylene	0.38 :	4.3	2 / 21	0.03	29	1.7607	1.7607	10000	No
Benzo(k)Fluoranthene	0.38 :	4.3	4 / 21	0.025	66	3.4991	3.4991	400	No
Benzoic Acid	1.9 :	770	9 / 21	0.07	1.8	19.38	1.8	NA	NA
Butylbenzylphthalate	0.38 :	160	1 / 21	0.8	0.8	4.2102	0.8	NA	NA
Chrysene	0.39 :	4.3	5 / 21	0.015	150	7.4942	7.4942	400	No
Di-n-butylphthalate	0.44 :	160	12 / 21	0.013	1.4	4.042	1.4	NA	NA
Di-n-octylphthalate	0.38 :	160	2 / 21	0.012	0.17	4.1706	0.17	NA	NA
Dibenzofuran	0.38 :	4.3	1 / 21	39	39	2.246	2.246	NA	NA
Diethylphthalate	0.38 :	160	6 / 21	0.015	0.053	4.1075	0.053	10000	No
Fluoranthene	0.39 :	4.3	8 / 21	0.027	410	19.8202	19.8202	10000	No
Fluorene	0.38 :	4.3	2 / 21	0.008	430	20.8549	20.8549	10000	No
Indeno (1,2,3-cd)Pyrene	0.38 :	4.3	3 / 21	0.031	24	1.4995	1.4995	100	No
N-Nitrosodiphenylamine	0.39 :	160	3 / 20	0.26	1	4.3093	1	NA	NA

TABLE 73
COMPARISON OF SURFACE SOIL EPCs TO UCLs - AREA 8 HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]	UCL [4]	EPC Exceeds UCL?
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean			
Naphthalene	0.39	4.3	3 / 20	0.008	530	26.8656	26.8656	10000	No
Phenanthrene	0.39	0.96	8 / 20	0.03	1000	50.191	50.191	10000	No
Phenol	0.39	160	1 / 20	2.4	2.4	4.4913	2.4	10000	No
Pyrene	0.39	0.96	9 / 20	0.024	320	16.1793	16.1793	10000	No
bis(2-EthylHexyl)phthalate	0.43	160	16 / 21	0.0655	89	10.2296	10.2296	10000	No
Pesticides/PCBs (mg/Kg)									
4,4'-DDD	0.0039	0.045	7 / 21	0.0002	0.017	0.0043	0.0043	100	No
4,4'-DDE	0.0039	0.045	11 / 21	0.0005	0.011	0.0037	0.0037	90	No
4,4'-DDT	0.0039	0.045	13 / 21	0.0014	0.04	0.0082	0.0082	90	No
Aldrin	0.002	0.022	2 / 21	0.0001	0.001	0.0018	0.001	1	No
Alpha-BHC	0.002	0.022	3 / 21	0.0002	0.0011	0.0019	0.0011	NA	NA
Alpha-Chlordane	0.002	0.22	3 / 21	0.0008	0.052	0.009	0.009	50	No
Dieldrin	0.0039	0.045	8 / 21	0.0004	0.012	0.004	0.004	2	No
Endosulfan I	0.002	0.022	2 / 21	0.0019	0.099	0.0064	0.0064	4000	No
Endrin Ketone	0.0039	0.045	1 / 21	0.0031	0.0031	0.0038	0.0031	NA	NA
Gamma-BHC (Lindane)	0.002	0.022	10 / 21	0.0001	0.17	0.0131	0.0131	20	No
Gamma-Chlordane	0.002	0.22	1 / 21	0.0003	0.0003	0.0066	0.0003	50	No
Heptachlor	0.002	0.022	2 / 21	0.0003	0.0004	0.0018	0.0004	7	No
Heptachlor Epoxide	0.002	0.022	1 / 21	0.0001	0.0001	0.0019	0.0001	3	No
Metals (mg/Kg)									
Aluminum	0	0	8 / 8	1700	9100	3671.25	3671.25	NA	NA
Antimony	0.97	20	1 / 8	1.3	1.3	1.84	1.3	400	No
Arsenic	0.9	0.9	7 / 8	2.2	24.5	6.5313	6.5313	300	No
Barium	0	0	8 / 8	3.6	21	10.85	10.85	10000	No
Calcium	0	0	8 / 8	91	53000	9826.75	9826.75	NA	NA
Chromium	0	0	21 / 21	2.6	3010	254.7905	254.791	10000	No
Cobalt	0.21	0.21	7 / 8	0.42	3.9	1.4094	1.4094	NA	NA
Iron	0	0	8 / 8	1200	20000	5596.25	5596.25	NA	NA

TABLE 73
COMPARISON OF SURFACE SOIL EPCs TO UCLs - AREA 8 HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]	UCL [4]	EPC Exceeds UCL?
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean			
Lead	0	0	8 / 8	2.3	34	15.2	15.2	6000	No
Manganese	0	0	8 / 8	3.9	99.9	33.7875	33.7875	NA	NA
Mercury	0.089	0.12	4 / 8	0.09	0.38	0.1495	0.1495	600	No
Nickel	0	0	8 / 8	0.96	9.3	3.295	3.295	7000	No
Selenium	0.9	1.1	3 / 8	1.1	2.2	0.8581	0.8581	10000	No
Sodium	0	0	8 / 8	66	130	86.925	86.925	NA	NA
Thallium	1.4	1.7	1 / 8	0.88	0.88	0.8288	0.8288	1000	No
Vanadium	0	0	8 / 8	4.8	18.4	10.325	10.325	10000	No
Zinc	0	0	8 / 8	4.8	41.4	16.15	16.15	10000	No
Inorganics (mg/Kg)									
Chloride	0	0	1 / 1	110	110	110	110	NA	NA
Nitrogen, Ammonia	0	0	19 / 19	15.65	363	163.9079	163.908	NA	NA
Sulfate as SO4	130	430	17 / 19	150	28000	7253.158	7253.16	NA	NA

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 1.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.
4 UCL = Upper Concentration Limit in Soil (310 CMR 40.0996(5); 4/5/96)
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 74
COMPARISON OF SURFACE SOIL EPCs TO UCLs - DRUM AREA A HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]	UCL [4]	EPC Exceeds UCL?
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean			
VOCs (mg/Kg)									
1,1,1-Trichloroethane	0.005 :	0.005	5 / 8	0.002	0.018	0.0068	0.0068	5000	No
Acetone	0 :	0	8 / 8	0.006	0.021	0.012	0.012	10000	No
Toluene	0.005 :	0.006	1 / 8	0.0009	0.0009	0.0024	0.0009	10000	No
SVOCs (mg/Kg)									
Di-n-butylphthalate	0 :	0	2 / 2	0.13	0.2	0.165	0.165	NA	NA
Fluoranthene	9.1 :	9.1	1 / 2	0.045	0.045	2.2975	0.045	10000	No
N-Nitrosodiphenylamine	0 :	0	2 / 2	2.7	2.8	2.75	2.75	NA	NA
bis(2-EthylHexyl)phthalate	0 :	0	2 / 2	1.3	5.3	3.3	3.3	10000	No
Pesticides/PCBs (mg/Kg)									
4,4'-DDD	0 :	0	2 / 2	0.0017	0.0034	0.0026	0.0026	100	No
4,4'-DDE	0.0037 :	0.0037	1 / 2	0.0019	0.0019	0.0019	0.0019	90	No
4,4'-DDT	0 :	0	2 / 2	0.0031	0.0064	0.0048	0.0048	90	No
Aldrin	0 :	0	2 / 2	0.0005	0.0012	0.0009	0.0009	1	No
Alpha-BHC	0 :	0	2 / 2	0.0016	0.005	0.0033	0.0033	NA	NA
Alpha-Chlordane	0 :	0	2 / 2	0.0036	0.0045	0.0041	0.0041	50	No
Dieldrin	0.0037 :	0.0037	1 / 2	0.0069	0.0069	0.0044	0.0044	2	No
Endosulfan I	0 :	0	2 / 2	0.0047	0.0056	0.0052	0.0052	4000	No
Endrin Ketone	0.0038 :	0.0038	1 / 2	0.0048	0.0048	0.0034	0.0034	NA	NA
Gamma-BHC (Lindane)	0 :	0	2 / 2	0.0034	0.0047	0.0041	0.0041	20	No
Gamma-Chlordane	0.0019 :	0.0019	1 / 2	0.0088	0.0088	0.0049	0.0049	50	No
Heptachlor	0.0019 :	0.0019	1 / 2	0.0009	0.0009	0.0009	0.0009	7	No
Heptachlor Epoxide	0.0019 :	0.0019	1 / 2	0.0028	0.0028	0.0019	0.0019	3	No
Metals (mg/Kg)									
Aluminum	0 :	0	2 / 2	5560	12900	9230	9230	NA	NA
Antimony	0 :	0	2 / 2	1.2	1.2	1.2	1.2	400	No
Arsenic	0 :	0	2 / 2	9.7	30.9	20.3	20.3	300	No
Barium	0 :	0	2 / 2	22.3	43.2	32.75	32.75	10000	No

TABLE 74
COMPARISON OF SURFACE SOIL EPCs TO UCLs - DRUM AREA A HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]	UCL [4]	EPC Exceeds UCL?
Beryllium	0	0	2 / 2	0.32	0.61	0.465	0.465	30	No
Calcium	0	0	2 / 2	1850	2060	1955	1955	NA	NA
Chromium	0	0	2 / 2	24.1	40.2	32.15	32.15	10000	No
Cobalt	0	0	2 / 2	3.9	11.3	7.6	7.6	NA	NA
Iron	0	0	2 / 2	7580	17200	12390	12390	NA	NA
Lead	0	0	2 / 2	9.4	17	13.2	13.2	6000	No
Manganese	0	0	2 / 2	109	351	230	230	NA	NA
Mercury	0.09	0.09	1 / 2	0.11	0.11	0.0775	0.0775	600	No
Nickel	0	0	2 / 2	10.2	30.1	20.15	20.15	7000	No
Selenium	0	0	2 / 2	0.96	1	0.98	0.98	10000	No
Sodium	0	0	2 / 2	131	174	152.5	152.5	NA	NA
Thallium	0	0	2 / 2	1.8	1.8	1.8	1.8	1000	No
Vanadium	0	0	2 / 2	11.3	24.9	18.1	18.1	10000	No
Zinc	0	0	2 / 2	37.2	63	50.1	50.1	10000	No
Inorganics (mg/Kg)									
Nitrogen, Ammonia	0	0	2 / 2	47.4	93	70.2	70.2	NA	NA
Sulfate as SO4	0	0	2 / 2	260	2310	1285	1285	NA	NA

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 1.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.
4 UCL = Upper Concentration Limit in Soil (310 CMR 40.0996(5); 4/5/96)
EPC = Exposure Point Concentration

TABLE 74
COMPARISON OF SURFACE SOIL EPCs TO UCLs - DRUM AREA A HOT SPOT

Olin Corporation
Wilmington, MA Facility

	Site Data/Concentration [2]								
	Minimum	Maximum	Frequency of			Arithmetic			EPC Exceeds
OHM of Concern [1]	SQL	SQL	Detection	Minimum	Maximum	Mean	EPC [3]	UCL [4]	UCL?

OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 75
COMPARISON OF SURFACE SOIL EPCs TO UCLs - LAKE POLY HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Minimum SQL : Maximum SQL (Site Data/Concentration [2])	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]	UCL [4]	EPC Exceeds UCL?
VOCs (mg/Kg)								
1,1,1-Trichloroethane	0 : 0	3 / 3	0.003	0.011	0.0066	0.0066	5000	No
2-Butanone (MEK)	0.011 : 0.011	1 / 3	0.004	0.004	0.005	0.004	10000	No
Acetone	0 : 0	3 / 3	0.018	0.026	0.0212	0.0212	10000	No
Methylene Chloride	0.005 : 0.005	1 / 3	0.002	0.002	0.0023	0.002	7000	No
Toluene	0.005 : 0.005	2 / 3	0.0009	0.001	0.0017	0.001	10000	No
SVOCs (mg/Kg)								
Acenaphthylene	0.35 : 37	1 / 3	0.027	0.027	6.2587	0.027	10000	No
Anthracene	0.35 : 37	1 / 3	0.022	0.022	6.2323	0.022	10000	No
Benzo(a)Anthracene	37 : 37	2 / 3	0.008	0.07	6.1927	0.07	100	No
Benzo(b)Fluoranthene	37 : 37	2 / 3	0.013	0.107	6.2067	0.107	100	No
Benzo(k)Fluoranthene	37 : 37	2 / 3	0.019	0.0925	6.2038	0.0925	400	No
Benzoic Acid	1.7 : 180	1 / 3	0.096	0.096	30.3153	0.096	NA	NA
Butylbenzylphthalate	0.35 : 37	1 / 3	0.029	0.029	6.259	0.029	NA	NA
Chrysene	37 : 37	2 / 3	0.016	0.088	6.2013	0.088	400	No
Di-n-butylphthalate	0 : 0	3 / 3	0.009	1	0.3512	0.3512	NA	NA
Di-n-octylphthalate	0.35 : 37	1 / 3	0.022	0.022	6.2612	0.022	NA	NA
Dibenzofuran	0.35 : 37	1 / 3	0.016	0.016	6.2568	0.016	NA	NA
Diethylphthalate	0.35 : 37	1 / 3	0.0245	0.0245	6.2332	0.0245	10000	No
Fluoranthene	37 : 37	2 / 3	0.022	0.163	6.2283	0.163	10000	No
Fluorene	0.35 : 37	1 / 3	0.02	0.02	6.2575	0.02	10000	No
N-Nitrosodiphenylamine	0.35 : 0.35	2 / 3	0.097	210	70.1037	70.1037	NA	NA
Naphthalene	0.35 : 37	1 / 3	0.013	0.013	6.2563	0.013	10000	No
Phenanthrene	0.35 : 37	1 / 3	0.128	0.128	6.2677	0.128	10000	No
Pyrene	37 : 37	2 / 3	0.017	0.161	6.226	0.161	10000	No
bis(2-EthylHexyl)phthalate	0 : 0	3 / 3	0.18	5.1	1.873	1.873	10000	No

TABLE 75
COMPARISON OF SURFACE SOIL EPCs TO UCLs - LAKE POLY HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]	UCL [4]	EPC Exceeds UCL?
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean			
Pesticides/PCBs (mg/Kg)									
4,4'-DDD	0.0035 :	0.018	1 / 3	0.0007	0.0007	0.0038	0.0007	100	No
4,4'-DDE	0.0035 :	0.018	1 / 3	0.001	0.001	0.0039	0.001	90	No
4,4'-DDT	0.018 :	0.018	2 / 3	0.0023	0.0088	0.0067	0.0067	90	No
Alpha-Chlordane	0.0018 :	0.0094	1 / 3	0.0034	0.0034	0.0026	0.0026	50	No
Endrin	0.0035 :	0.018	1 / 3	0.0004	0.0004	0.0039	0.0004	100	No
Gamma-BHC (Lindane)	0.0094 :	0.0094	2 / 3	0.0001	0.0004	0.0019	0.0004	20	No
Gamma-Chlordane	0.0018 :	0.0094	1 / 3	0.0012	0.0012	0.0022	0.0012	50	No
Metals (mg/Kg)									
Aluminum	0 :	0	3 / 3	3440	4840	4055	4055	NA	NA
Antimony	0 :	0	3 / 3	1	1.2	1.025	1.025	400	No
Arsenic	0 :	0	3 / 3	3.9	4.2	4.0667	4.0667	300	No
Barium	0 :	0	3 / 3	6.5	12.9	10.5667	10.5667	10000	No
Beryllium	0 :	0	3 / 3	0.2	0.26	0.2092	0.2092	30	No
Calcium	0 :	0	3 / 3	318	518	444.1667	444.167	NA	NA
Chromium	0 :	0	3 / 3	28.9	203	90.3167	90.3167	10000	No
Cobalt	0 :	0	3 / 3	1.5	2.5	1.9833	1.9833	NA	NA
Iron	0 :	0	3 / 3	4810	5950	5253.333	5253.33	NA	NA
Lead	0 :	0	3 / 3	4.8	93.65	37.8167	37.8167	6000	No
Manganese	0 :	0	3 / 3	39.8	60.5	52.5667	52.5667	NA	NA
Mercury	0.1 :	0.1	2 / 3	0.125	0.14	0.105	0.105	600	No
Nickel	0 :	0	3 / 3	5.3	6.1	5.6	5.6	7000	No
Selenium	0 :	0	3 / 3	0.88	1	0.9517	0.9517	10000	No
Sodium	0 :	0	3 / 3	77.4	114	99.4667	99.4667	NA	NA
Thallium	1.6 :	1.6	2 / 3	1.6	1.85	1.4167	1.4167	1000	No
Vanadium	0 :	0	3 / 3	7.2	9	8.1333	8.1333	10000	No
Zinc	0 :	0	3 / 3	27.1	43.6	35.2667	35.2667	10000	No

TABLE 75
COMPARISON OF SURFACE SOIL EPCs TO UCLs - LAKE POLY HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]	UCL [4]	EPC Exceeds UCL?
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean			
Inorganics (mg/Kg)									
Nitrogen, Ammonia	0	0	3 / 3	23.8	66.6	44.2667	44.2667	NA	NA

Notes:

1 Selection of OHM of Concern for this medium is presented in Table 1.

2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.

3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.

4 UCL = Upper Concentration Limit in Soil (310 CMR 40.0996(5); 4/5/96)

EPC = Exposure Point Concentration

OHM = Oil or Hazardous Material

SQL = Sample Quantitation Limit

MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 76
COMPARISON OF SURFACE SOIL EPCs TO UCLs - AREA WITHOUT BUILDINGS
(EXCLUDING HOT SPOTS AND SULFATE LANDFILL)

Olin Corporation
Wilmington, MA Facility

	Site Data/Concentration [2]								
OHM of Concern [1]	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]	UCL [4]	EPC Exceeds UCL?
VOCs (mg/Kg)									
1,1,1-Trichloroethane	0.005 :	0.01	8 / 16	0.005	0.23	0.0237	0.0237	5000	No
1,1-Dichloroethene	0.005 :	0.01	1 / 16	0.018	0.018	0.0043	0.0043	90	No
Acetone	0.012 :	0.024	11 / 16	0.005	0.036	0.0153	0.0153	10000	No
Methylene Chloride	0.005 :	0.041	6 / 16	0.002	0.008	0.0052	0.0052	7000	No
Toluene	0.005 :	0.01	2 / 16	0.003	0.004	0.0034	0.0034	10000	No
SVOCs (mg/Kg)									
Acenaphthylene	0.39 :	1.1	2 / 6	0.008	0.045	0.2213	0.045	10000	No
Anthracene	0.39 :	1.1	1 / 6	0.005	0.005	0.2967	0.005	10000	No
Benzo(a)Anthracene	0.39 :	1	2 / 6	0.012	0.099	0.2227	0.099	100	No
Benzo(a)Pyrene	0.39 :	1	2 / 6	0.011	0.059	0.2158	0.059	100	No
Benzo(b)Fluoranthene	0.39 :	1	2 / 6	0.013	0.18	0.2363	0.18	100	No
Benzo(k)Fluoranthene	0.39 :	1	2 / 6	0.012	0.065	0.217	0.065	400	No
Benzoic Acid	1.9 :	5.3	3 / 6	0.24	0.79	1.065	0.79	NA	NA
Chrysene	0.39 :	1	2 / 6	0.016	0.17	0.2352	0.17	400	No
Di-n-butylphthalate	1 :	1.1	4 / 6	0.013	0.065	0.1958	0.065	NA	NA
Diethylphthalate	0.58 :	1.1	3 / 6	0.013	0.044	0.235	0.044	10000	No
Fluoranthene	0.39 :	1	3 / 6	0.011	0.25	0.212	0.212	10000	No
Indeno (1,2,3-cd)Pyrene	0.39 :	1	1 / 6	0.064	0.064	0.2557	0.064	100	No
N-Nitrosodiphenylamine	0.39 :	1.1	1 / 6	0.3	0.3	0.3033	0.3	NA	NA
Phenanthrene	0.39 :	1	3 / 6	0.012	0.16	0.196	0.16	10000	No
Pyrene	0.39 :	1	3 / 6	0.013	0.16	0.1963	0.16	10000	No
bis(2-EthylHexyl)phthalate	0 :	0	6 / 6	0.13	5.2	1.515	1.515	10000	No
Pesticides/PCBs (mg/Kg)									
4,4'-DDD	0.0038 :	0.053	3 / 7	0.0001	0.0005	0.0087	0.0005	100	No
4,4'-DDE	0.0038 :	0.053	3 / 7	0.0016	0.0026	0.0095	0.0026	90	No
4,4'-DDT	0.0038 :	0.053	4 / 7	0.0014	0.014	0.0104	0.0104	90	No

TABLE 76
COMPARISON OF SURFACE SOIL EPCs TO UCLs - AREA WITHOUT BUILDINGS (EXCLUDING HOT SPOTS AND SULFATE LANDFILL)

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]	UCL [4]	EPC Exceeds UCL?
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean			
Aldrin	0.002 :	0.026	2 / 7	0.0019	0.003	0.0044	0.003	1	No
Alpha-Chlordane	0.002 :	0.26	1 / 7	0.0003	0.0003	0.0336	0.0003	50	No
Dieldrin	0.0038 :	0.038	2 / 7	0.0009	0.001	0.0073	0.001	2	No
Endosulfan I	0.002 :	0.026	1 / 7	0.0021	0.0021	0.0049	0.0021	4000	No
Endrin	0.0038 :	0.053	1 / 7	0.0072	0.0072	0.0089	0.0072	100	No
Endrin Ketone	0.0038 :	0.053	1 / 7	0.0014	0.0014	0.0095	0.0014	NA	NA
Gamma-BHC (Lindane)	0.002 :	0.026	2 / 7	0.0052	0.14	0.0245	0.0245	20	No
Gamma-Chlordane	0.002 :	0.26	1 / 7	0.0052	0.0052	0.0343	0.0052	50	No
Heptachlor Epoxide	0.002 :	0.026	1 / 7	0.0004	0.0004	0.0047	0.0004	3	No
Metals (mg/Kg)									
Aluminum	0 :	0	6 / 6	2250	8000	4826.667	4826.67	NA	NA
Arsenic	0 :	0	6 / 6	1.2	24	8.0333	8.0333	300	No
Barium	0 :	0	6 / 6	5.3	25	13.9167	13.9167	10000	No
Calcium	0 :	0	6 / 6	85.7	1200	627.1833	627.183	NA	NA
Chromium	0 :	0	7 / 7	3.5	320	63.6286	63.6286	10000	No
Cobalt	0.24 :	0.24	5 / 6	0.43	9.9	2.5417	2.5417	NA	NA
Iron	0 :	0	6 / 6	2090	16000	6990	6990	NA	NA
Lead	0 :	0	6 / 6	2	210	52.7667	52.7667	6000	No
Manganese	0 :	0	6 / 6	3.7	530	109.15	109.15	NA	NA
Mercury	0.11 :	0.18	2 / 6	0.11	0.12	0.0842	0.0842	600	No
Nickel	0 :	0	6 / 6	1.5	7.6	4.1	4.1	7000	No
Selenium	0.5 :	1.4	1 / 6	0.91	0.91	0.5175	0.5175	10000	No
Sodium	0 :	0	6 / 6	34	120	62.1	62.1	NA	NA
Thallium	0.52 :	2.2	2 / 6	0.8	1.4	0.885	0.885	1000	No
Vanadium	0 :	0	6 / 6	4.3	34	14.8333	14.8333	10000	No
Zinc	0 :	0	6 / 6	5.1	72	22.5167	22.5167	10000	No

TABLE 76
COMPARISON OF SURFACE SOIL EPCs TO UCLs - AREA WITHOUT BUILDINGS (EXCLUDING HOT SPOTS AND SULFATE LANDFILL)

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]	UCL [4]	EPC Exceeds UCL?
Inorganics (mg/Kg)									
Chloride	0	0	2 / 2	49	56	52.5	52.5	NA	NA
Nitrogen, Ammonia	0	0	5 / 5	27	168	99	99	NA	NA
Sulfate as SO4	0	0	5 / 5	83	19400	4048.6	4048.6	NA	NA

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 1.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.
4 UCL = Upper Concentration Limit in Soil (310 CMR 40.0996(5); 4/5/96)
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 77
COMPARISON OF SURFACE SOIL EPCs TO UCLs - SULFATE LANDFILL

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]	UCL [4]	EPC Exceeds UCL?
VOCs (mg/Kg)									
Toluene	0 : 0		1 / 1	0.003	0.003	0.003	0.003	10000	No
SVOCs (mg/Kg)									
Benzo(a)Anthracene	0 : 0		1 / 1	0.038	0.038	0.038	0.038	100	No
Benzo(a)Pyrene	0 : 0		1 / 1	0.046	0.046	0.046	0.046	100	No
Benzo(b)Fluoranthene	0 : 0		1 / 1	0.0665	0.0665	0.0665	0.0665	100	No
Benzo(g,h,i)Perylene	0 : 0		1 / 1	0.029	0.029	0.2645	0.029	10000	No
Benzo(k)Fluoranthene	0 : 0		1 / 1	0.018	0.018	0.259	0.018	400	No
Chrysene	0 : 0		1 / 1	0.0445	0.0445	0.0445	0.0445	400	No
Di-n-butylphthalate	0 : 0		1 / 1	0.017	0.017	0.181	0.017	NA	NA
Fluoranthene	0 : 0		1 / 1	0.0825	0.0825	0.0825	0.0825	10000	No
Indeno (1,2,3-cd)Pyrene	0 : 0		1 / 1	0.047	0.047	0.047	0.047	100	No
Phenanthrene	0 : 0		1 / 1	0.042	0.042	0.042	0.042	10000	No
Pyrene	0 : 0		1 / 1	0.063	0.063	0.063	0.063	10000	No
bis(2-EthylHexyl)phthalate	0 : 0		1 / 1	0.083	0.083	0.083	0.083	10000	No
Metals (mg/Kg)									
Aluminum	0 : 0		1 / 1	9750	9750	4826.667	4826.67	NA	NA
Arsenic	0 : 0		1 / 1	12	12	8.0333	8.0333	300	No
Barium	0 : 0		1 / 1	28	28	13.9167	13.9167	10000	No
Calcium	0 : 0		1 / 1	1350	1350	627.1833	627.183	NA	NA
Chromium	0 : 0		1 / 1	17.5	17.5	63.6286	17.5	10000	No
Cobalt	0 : 0		1 / 1	3.7	3.7	2.5417	2.5417	NA	NA
Iron	0 : 0		1 / 1	10000	10000	6990	6990	NA	NA
Lead	0 : 0		1 / 1	28.5	28.5	52.7667	28.5	6000	No
Manganese	0 : 0		1 / 1	140	140	109.15	109.15	NA	NA
Nickel	0 : 0		1 / 1	10	10	4.1	4.1	7000	No
Selenium	0 : 0		1 / 1	0.66	0.66	0.5175	0.5175	10000	No
Sodium	0 : 0		1 / 1	37	37	62.1	37	NA	NA

TABLE 77
COMPARISON OF SURFACE SOIL EPCs TO UCLs - SULFATE LANDFILL

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]	UCL [4]	EPC Exceeds UCL?
Thallium	0	0	1 / 1	0.66	0.66	0.885	0.66	1000	No
Vanadium	0	0	1 / 1	17.5	17.5	14.8333	14.8333	10000	No
Zinc	0	0	1 / 1	38	38	22.5167	22.5167	10000	No
Inorganics (mg/Kg)									
Chloride	0	0	1 / 1	61.5	61.5	61.5	61.5	NA	NA
Nitrogen, Ammonia	0	0	1 / 1	17	17	17	17	NA	NA
Sulfate as SO4	0	0	1 / 1	30.5	30.5	30.5	30.5	NA	NA

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 1.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.
4 UCL = Upper Concentration Limit in Soil (310 CMR 40.0996(5); 4/5/96)
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 78
COMPARISON OF SURFACE SOIL EPCs TO UCLs - SWMU 27 HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL : Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]	UCL [4]	EPC Exceeds UCL?
VOCs (mg/Kg)								
Acetone	0 : 0	1 / 1	0.093	0.093	0.093	0.093	10000	No
Methylene Chloride	0 : 0	1 / 1	0.047	0.047	0.047	0.047	7000	No
Tetrachloroethene (PCE)	0 : 0	1 / 1	0.073	0.073	0.073	0.073	1000	No
Toluene	0 : 0	1 / 1	0.015	0.015	0.015	0.015	10000	No
SVOCs (mg/Kg)								
Anthracene	0.52 : 2.5	1 / 3	0.002	0.002	0.504	0.002	10000	No
Benzo(a)Anthracene	0.52 : 2.5	1 / 3	0.008	0.008	0.506	0.008	100	No
Benzo(b)Fluoranthene	0.52 : 2.5	1 / 3	0.01	0.01	0.5067	0.01	100	No
Benzo(k)Fluoranthene	0.52 : 2.5	1 / 3	0.006	0.006	0.5053	0.006	400	No
Benzoic Acid	12 : 12	2 / 3	0.039	0.1	2.0463	0.1	NA	NA
Butylbenzylphthalate	0.4 : 0.52	1 / 3	2.6	2.6	1.02	1.02	NA	NA
Chrysene	0.52 : 2.5	1 / 3	0.012	0.012	0.5073	0.012	400	No
Di-n-butylphthalate	0 : 0	3 / 3	0.02	10	3.3567	3.3567	NA	NA
Di-n-octylphthalate	0.4 : 0.52	1 / 3	4.7	4.7	1.72	1.72	NA	NA
Diethylphthalate	2.5 : 2.5	2 / 3	0.01	0.033	0.431	0.033	10000	No
Fluoranthene	2.5 : 2.5	2 / 3	0.008	0.015	0.4243	0.015	10000	No
N-Nitrosodiphenylamine	0.52 : 0.52	2 / 3	0.075	32	10.7783	10.7783	NA	NA
Phenanthrene	0.52 : 2.5	1 / 3	0.011	0.011	0.507	0.011	10000	No
Pyrene	2.5 : 2.5	2 / 3	0.011	0.015	0.4253	0.015	10000	No
bis(2-EthylHexyl)phthalate	0 : 0	3 / 3	0.47	5500	1833.81	1833.81	10000	No
Pesticides/PCBs (mg/Kg)						0		
4,4'-DDE	0.04 : 0.04	2 / 3	0.002	0.0026	0.0082	0.0026	90	No
4,4'-DDT	0.04 : 0.04	2 / 3	0.0023	0.015	0.0124	0.0124	90	No
Alpha-BHC	0.002 : 0.0027	1 / 3	0.22	0.22	0.0741	0.0741	NA	NA
Alpha-Chlordane	0.0027 : 0.2	1 / 3	0.0002	0.0002	0.0339	0.0002	50	No
Dieldrin	0.004 : 0.04	1 / 3	0.0008	0.0008	0.0076	0.0008	2	No
Endosulfan II	0.004 : 0.0052	1 / 3	0.092	0.092	0.0322	0.0322	4000	No

TABLE 78
COMPARISON OF SURFACE SOIL EPCs TO UCLs - SWMU 27 HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL : Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]	UCL [4]	EPC Exceeds UCL?
Gamma-BHC (Lindane)	0.002 : 0.04	1 / 3	0.0001	0.0001	0.007	0.0001	20	No
Gamma-Chlordane	0.0027 : 0.02	1 / 3	0.0003	0.0003	0.0039	0.0003	50	No
Heptachlor Epoxide	0.002 : 0.02	1 / 3	0.0001	0.0001	0.0037	0.0001	3	No
Metals (mg/Kg)								
Aluminum	0 : 0	3 / 3	2030	8340	5190	5190	NA	NA
Antimony	1.1 : 1.1	2 / 3	1.2	76	25.9167	25.9167	400	No
Arsenic	1.6 : 1.6	2 / 3	4.3	7.5	4.2	4.2	300	No
Barium	0 : 0	3 / 3	11.5	21	14.8	14.8	10000	No
Calcium	0 : 0	3 / 3	61.1	388	229.7	229.7	NA	NA
Chromium	0 : 0	3 / 3	3	4500	1661	1661	10000	No
Cobalt	0 : 0	3 / 3	0.46	1.7	1.2867	1.2867	NA	NA
Iron	0 : 0	3 / 3	2310	6800	4870	4870	NA	NA
Lead	0 : 0	3 / 3	8.2	76.3	33.5	33.5	6000	No
Manganese	0 : 0	3 / 3	1.7	43	21.5667	21.5667	NA	NA
Mercury	0.12 : 0.14	1 / 3	2.8	2.8	0.9767	0.9767	600	No
Nickel	0 : 0	3 / 3	4	6.1	5.3	5.3	7000	No
Sodium	0 : 0	3 / 3	32	90.6	59.9	59.9	NA	NA
Vanadium	0 : 0	3 / 3	14	15.5	14.6667	14.6667	10000	No
Zinc	0 : 0	3 / 3	14.9	42	25.2	25.2	10000	No
Inorganics (mg/Kg)								
Nitrogen, Ammonia	0 : 0	1 / 1	670	670	670	670	NA	NA
Sulfate as SO4	0 : 0	1 / 1	82	82	82	82	NA	NA

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 1.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value

TABLE 78
COMPARISON OF SURFACE SOIL EPCs TO UCLs - SWMU 27 HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]	UCL [4]	EPC Exceeds UCL?
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean			

for non-detects.

3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.

4 UCL = Upper Concentration Limit in Soil (310 CMR 40.0996(5); 4/5/96)

EPC = Exposure Point Concentration

OHM = Oil or Hazardous Material

SQL = Sample Quantitation Limit

MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

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TABLE 79
COMPARISON OF SURFACE SOIL EPCs TO UCLs - SWMU 30 HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]	UCL [4]	EPC Exceeds UCL?
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean			
VOCs (mg/Kg)									
Toluene	0	0	1 / 1	0.013	0.013	0.013	0.013	10000	No
SVOCs (mg/Kg)									
Di-n-butylphthalate	0	0	1 / 1	0.4	0.4	0.4	0.4	NA	NA
N-Nitrosodiphenylamine	0	0	1 / 1	2.8	2.8	2.8	2.8	NA	NA
bis(2-EthylHexyl)phthalate	0	0	1 / 1	200	200	200	200	10000	No
Pesticides/PCBs (mg/Kg)									
4,4'-DDT	0.065	0.065	1 / 2	1.7	1.7	0.8663	0.8663	90	No
Alpha-BHC	0.027	0.027	1 / 2	0.0058	0.0058	0.0097	0.0058	NA	NA
Endosulfan II	0.065	0.065	1 / 2	0.34	0.34	0.1863	0.1863	4000	No
Metals (mg/Kg)									
Aluminum	0	0	2 / 2	3080	7300	5190	5190	NA	NA
Antimony	1.3	1.3	1 / 2	54	54	27.325	27.325	400	No
Arsenic	0	0	2 / 2	4.4	13	8.7	8.7	300	No
Barium	0	0	2 / 2	17.7	47	32.35	32.35	10000	No
Calcium	0	0	2 / 2	258	650	454	454	NA	NA
Chromium	0	0	2 / 2	200	3600	1900	1900	10000	No
Cobalt	0	0	2 / 2	1	4.4	2.7	2.7	NA	NA
Cyanide	0	0	1 / 1	7.5	7.5	7.5	7.5	4000	No
Iron	0	0	2 / 2	3240	17000	10120	10120	NA	NA
Lead	0	0	2 / 2	24.2	38	31.1	31.1	6000	No
Manganese	0	0	2 / 2	9.3	52	30.65	30.65	NA	NA
Mercury	0	0	2 / 2	0.15	3.2	1.675	1.675	600	No
Nickel	0	0	2 / 2	5.1	9.7	7.4	7.4	7000	No
Selenium	0	0	2 / 2	0.51	1.5	1.005	1.005	10000	No
Sodium	0	0	2 / 2	197	360	278.5	278.5	NA	NA
Vanadium	0	0	2 / 2	9.8	24	16.9	16.9	10000	No
Zinc	0	0	2 / 2	8.3	32	20.15	20.15	10000	No

TABLE 79
COMPARISON OF SURFACE SOIL EPCs TO UCLs - SWMU 30 HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]	UCL [4]	EPC Exceeds UCL?
Inorganics (mg/Kg)									
Chloride	0	0	1 / 1	250	250	250	250	NA	NA
Nitrogen, Ammonia	0	0	1 / 1	400	400	400	400	NA	NA
Sulfate as SO4	0	0	1 / 1	1200	1200	1200	1200	NA	NA

Notes:

1 Selection of OHM of Concern for this medium is presented in Table 1.

2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.

3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.

4 UCL = Upper Concentration Limit in Soil (310 CMR 40.0996(5); 4/5/96)

EPC = Exposure Point Concentration

OHM = Oil or Hazardous Material

SQL = Sample Quantitation Limit

MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 80
COMPARISON OF SURFACE SOIL EPCs TO UCLs - SWMU 33 HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]	UCL [4]	EPC Exceeds UCL?
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean			
VOCs (mg/Kg)									
Tetrachloroethene (PCE)	0	0	1 / 1	0.001	0.001	0.001	0.001	1000	No
Toluene	0	0	1 / 1	0.001	0.001	0.001	0.001	10000	No
SVOCs (mg/Kg)									
Anthracene	2.2	2.2	1 / 2	0.035	0.035	0.5675	0.035	10000	No
Di-n-butylphthalate	0	0	2 / 2	0.074	0.27	0.172	0.172	NA	NA
Diethylphthalate	2.2	2.2	1 / 2	0.085	0.085	0.5925	0.085	10000	No
Fluoranthene	2.2	2.2	1 / 2	0.081	0.081	0.5905	0.081	10000	No
N-Nitrosodiphenylamine	2.2	2.2	1 / 2	0.55	0.55	0.825	0.55	NA	NA
Phenanthrene	2.2	2.2	1 / 2	0.14	0.14	0.62	0.14	10000	No
Pyrene	2.3	2.3	1 / 2	0.085	0.085	0.6175	0.085	10000	No
bis(2-EthylHexyl)phthalate	0	0	2 / 2	20	34	27	27	10000	No
Pesticides/PCBs (mg/Kg)									
4,4'-DDE	0.1	0.1	1 / 2	0.0037	0.0037	0.0269	0.0037	90	No
4,4'-DDT	0.1	0.1	1 / 2	0.0016	0.0016	0.0258	0.0016	90	No
Aldrin	0.052	0.052	1 / 2	0.0001	0.0001	0.0131	0.0001	1	No
Dieldrin	0.1	0.1	1 / 2	0.0006	0.0006	0.0253	0.0006	2	No
PCB-1016	0	0	1 / 1	0.98	0.98	0.98	0.98	100	No
Metals (mg/Kg)									
Aluminum	0	0	2 / 2	9290	59000	34145	34145	NA	NA
Antimony	1	1	1 / 2	79	79	39.75	39.75	400	No
Arsenic	0	0	2 / 2	4.7	18	11.35	11.35	300	No
Barium	0	0	2 / 2	5.4	21	13.2	13.2	10000	No
Beryllium	0.25	0.25	1 / 2	4	4	2.0625	2.0625	30	No
Cadmium	0.25	0.25	1 / 2	5.8	5.8	2.9625	2.9625	800	No
Calcium	0	0	2 / 2	77.4	1400	738.7	738.7	NA	NA
Chromium	0	0	2 / 2	6.1	5000	2503.05	2503.05	10000	No
Cobalt	0	0	2 / 2	0.8	45	22.9	22.9	NA	NA

TABLE 80
COMPARISON OF SURFACE SOIL EPCs TO UCLs - SWMU 33 HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern[1]	Site Data/Concentration[2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC[3]	UCL[4]	EPC Exceeds UCL?
Cyanide	0 :	0	1 / 1	5.2	5.2	5.2	5.2	4000	No
Iron	0 :	0	2 / 2	6420	100000	53210	53210	NA	NA
Lead	0 :	0	2 / 2	7.5	62	34.75	34.75	6000	No
Manganese	0 :	0	2 / 2	9.4	140	74.7	74.7	NA	NA
Mercury	0.1 :	0.1	1 / 2	0.4	0.4	0.225	0.225	600	No
Nickel	0 :	0	2 / 2	2.5	67	34.75	34.75	7000	No
Sodium	0 :	0	2 / 2	49.9	680	364.95	364.95	NA	NA
Vanadium	0 :	0	2 / 2	11	37	24	24	10000	No
Zinc	0 :	0	2 / 2	5.6	180	92.8	92.8	10000	No
Inorganics (mg/Kg)									
Chloride	0 :	0	1 / 1	560	560	560	560	NA	NA
Nitrogen, Ammonia	0 :	0	1 / 1	300	300	300	300	NA	NA
Sulfate as SO4	0 :	0	1 / 1	2400	2400	2400	2400	NA	NA

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 1.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.
4 UCL = Upper Concentration Limit in Soil (310 CMR 40.0996(5); 4/5/96)
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 81
COMPARISON OF SURFACE SOIL EPCs TO UCLs - AREA WITH BUILDINGS (EXCLUDING HOT SPOTS)

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]	UCL [4]	EPC Exceeds UCL?
VOCs (mg/Kg)									
Tetrachloroethene (PCE)	0.005 :	0.0055	1 / 7	0.001	0.001	0.0024	0.001	1000	No
Toluene	0.005 :	0.007	2 / 7	0.002	0.003	0.0027	0.0027	10000	No
SVOCs (mg/Kg)									
2-Methylnaphthalene	0.33 :	0.99	2 / 7	0.067	0.075	0.2767	0.075	10000	No
Acenaphthylene	0.33 :	0.92	2 / 7	0.033	0.057	0.2529	0.057	10000	No
Anthracene	0.33 :	0.92	2 / 7	0.044	0.069	0.2561	0.069	10000	No
Benzo(a)Anthracene	0.33 :	0.33	6 / 7	0.029	0.36	0.1434	0.1434	100	No
Benzo(a)Pyrene	0 :	0	7 / 7	0.03	0.24	0.1074	0.1074	100	No
Benzo(b)Fluoranthene	0 :	0	7 / 7	0.039	0.56	0.1894	0.1894	100	No
Benzo(g,h,i)Perylene	0.33 :	0.92	2 / 7	0.041	0.12	0.2651	0.12	10000	No
Benzo(k)Fluoranthene	0.33 :	0.69	5 / 7	0.024	0.15	0.125	0.125	400	No
Butylbenzylphthalate	0.33 :	0.92	3 / 7	0.035	0.13	0.2251	0.13	NA	NA
Chrysene	0 :	0	7 / 7	0.053	0.64	0.2213	0.2213	400	No
Di-n-butylphthalate	0.33 :	0.92	5 / 7	0.014	0.036	0.1089	0.036	NA	NA
Di-n-octylphthalate	0.33 :	0.99	2 / 7	0.02	0.053	0.274	0.053	NA	NA
Dibenzo(a,h)Anthracene	0.33 :	0.99	1 / 7	0.074	0.074	0.3213	0.074	100	No
Diethylphthalate	0.33 :	0.99	1 / 7	0.033	0.033	0.3176	0.033	10000	No
Fluoranthene	0 :	0	7 / 7	0.072	0.94	0.3024	0.3024	10000	No
Indeno (1,2,3-cd)Pyrene	0.33 :	0.33	6 / 7	0.035	0.2	0.1016	0.1016	100	No
N-Nitrosodiphenylamine	0.33 :	0.92	2 / 7	0.059	0.48	0.3191	0.3191	NA	NA
Naphthalene	0.33 :	0.99	2 / 7	0.049	0.066	0.2729	0.066	10000	No
Phenanthrene	0 :	0	7 / 7	0.031	0.68	0.2106	0.2106	10000	No
Phenol	0.33 :	0.92	2 / 7	0.047	0.069	0.2587	0.069	10000	No
Pyrene	0 :	0	7 / 7	0.056	0.66	0.2327	0.2327	10000	No
bis(2-EthylHexyl)phthalate	0 :	0	7 / 7	0.13	2.2	1.06	1.06	10000	No

TABLE 81
COMPARISON OF SURFACE SOIL EPCs TO UCLs - AREA WITH BUILDINGS (EXCLUDING HOT SPOTS)

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]	UCL [4]	EPC Exceeds UCL?
Pesticides/PCBs (mg/Kg)									
4,4'-DDD	0.021 :	0.048	1 / 6	0.039	0.039	0.0218	0.0218	100	No
4,4'-DDE	0.021 :	0.048	1 / 6	0.049	0.049	0.0234	0.0234	90	No
4,4'-DDT	0.021 :	0.045	2 / 6	0.061	0.68	0.1348	0.1348	90	No
Metals (mg/Kg)									
Aluminum	0 :	0	7 / 7	4300	9000	5642.857	5642.86	NA	NA
Arsenic	0 :	0	7 / 7	6.8	19	10.7571	10.7571	300	No
Barium	0 :	0	7 / 7	14	42	26.8571	26.8571	10000	No
Cadmium	1 :	1	1 / 7	1.3	1.3	0.6143	0.6143	800	No
Calcium	0 :	0	7 / 7	670	5200	1668.571	1668.57	NA	NA
Chromium	0 :	0	7 / 7	8.8	85	28.2571	28.2571	10000	No
Cobalt	1.5 :	1.5	6 / 7	1.8	6.9	2.9929	2.9929	NA	NA
Iron	0 :	0	7 / 7	6600	16000	8528.571	8528.57	NA	NA
Lead	10 :	10	6 / 7	17	100	49.2857	49.2857	6000	No
Manganese	0 :	0	7 / 7	40	210	90.5714	90.5714	NA	NA
Mercury	0.1 :	0.1	3 / 7	0.01	0.15	0.0714	0.0714	600	No
Nickel	0 :	0	7 / 7	4.7	18	9.7571	9.7571	7000	No
Selenium	0.5 :	1.8	2 / 7	0.93	1.6	0.645	0.645	10000	No
Sodium	0 :	0	7 / 7	33	80	49.2857	49.2857	NA	NA
Thallium	0.5 :	0.93	1 / 7	0.63	0.63	0.3721	0.3721	1000	No
Vanadium	0 :	0	7 / 7	16	24	20	20	10000	No
Zinc	0 :	0	7 / 7	21	150	56.7143	56.7143	10000	No
Inorganics (mg/Kg)									
Chloride	40 :	40	1 / 7	68	68	26.8571	26.8571	NA	NA
Nitrogen, Ammonia	0 :	0	6 / 7	14	39	19.7143	19.7143	NA	NA
Sulfate as SO4	40 :	40	6 / 7	4.2	50	17.6857	17.6857	NA	NA

TABLE 81
COMPARISON OF SURFACE SOIL EPCs TO UCLs - AREA WITH BUILDINGS (EXCLUDING HOT SPOTS)

Olin Corporation
Wilmington, MA Facility

	Site Data/Concentration [2]								
OHM of Concern [1]	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]	UCL [4]	EPC Exceeds UCL?

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 1.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.
4 UCL = Upper Concentration Limit in Soil (310 CMR 40.0996(5); 4/5/96)
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 82
COMPARISON OF SUBSURFACE SOIL EPCs TO UCLs - LAKE POLY HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]	UCL [4]	EPC Exceeds UCL?
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean			
VOCs (mg/Kg)									
1,2-Dichloroethane	0.0055 :	0.043	1 / 11	0.002	0.002	0.0046	0.002	600	No
2,4,4-Trimethyl-1-pentene	0.011 :	0.011	10 / 11	0.006	340	32.3303	32.3303	NA	NA
2,4,4-Trimethyl-2-Pentene	0.011 :	0.017	8 / 11	0.002	210	20.0941	20.0941	NA	NA
2-Butanone (MEK)	0.016 :	0.02	4 / 11	0.007	0.084	0.0196	0.0196	10000	No
2-Hexanone	0.016 :	0.13	1 / 11	0.007	0.007	0.0137	0.007	NA	NA
Acetone	0.016 :	0.13	5 / 11	0.018	0.24	0.0605	0.0605	10000	No
Benzene	0.0055 :	0.043	2 / 11	0.001	0.002	0.0044	0.002	2000	No
Carbon Disulfide	0.011 :	0.085	2 / 11	0.005	0.013	0.0097	0.0097	NA	NA
Carbon Tetrachloride	0.0055 :	0.043	1 / 11	0.003	0.003	0.0046	0.003	400	No
Chlorobenzene	0.0055 :	0.006	2 / 11	0.053	0.53	0.0554	0.0554	10000	No
Chloroform	0.0055 :	0.043	1 / 11	0.001	0.001	0.0045	0.001	5000	No
Ethylbenzene	0.0055 :	0.006	4 / 11	0.015	0.61	0.0729	0.0729	10000	No
Methylene Chloride	0.011 :	0.012	4 / 11	0.002	0.02	0.0064	0.0064	7000	No
Styrene	0.0055 :	0.006	6 / 11	0.001	0.11	0.013	0.013	1000	No
Tetrachloroethene (PCE)	0.0055 :	0.006	2 / 11	0.005	0.023	0.0049	0.0049	1000	No
Toluene	0.0055 :	0.006	9 / 11	0.0006	1.1	0.1347	0.1347	10000	No
Xylenes, Total	0.0055 :	0.006	4 / 11	0.003	0.22	0.0338	0.0338	10000	No
SVOCs (mg/Kg)									
1,2,4-Trichlorobenzene	0.4 :	0.82	2 / 11	0.088	1.8	0.4539	0.4539	10000	No
1,2-Dichlorobenzene	0.4 :	0.82	2 / 11	0.17	2.1	0.4886	0.4886	5000	No
1,3-Dichlorobenzene	0.4 :	0.83	1 / 11	0.29	0.29	0.3464	0.29	5000	No
1,4-Dichlorobenzene	0.4 :	0.82	2 / 11	0.23	2.6	0.5396	0.5396	2000	No
2-Methylnaphthalene	0.4 :	0.83	1 / 11	0.063	0.063	0.318	0.063	10000	No
4-Bromophenyl-phenylether	0.4 :	0.83	1 / 4	1.1	1.1	0.4825	0.4825	NA	NA
4-Chlorophenyl-phenylether	0.4 :	0.82	2 / 11	0.17	2.2	0.4977	0.4977	NA	NA
Benzo(a)Anthracene	0.4 :	0.83	2 / 11	0.048	0.052	0.2855	0.052	100	No
Benzo(b)Fluoranthene	0.4 :	0.83	3 / 11	0.039	0.049	0.2537	0.049	100	No

TABLE 82
COMPARISON OF SUBSURFACE SOIL EPCs TO UCLs - LAKE POLY HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern[1]	Site Data/Concentration[2] Minimum SQL : Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC[3]	UCL[4]	EPC Exceeds UCL?
Butylbenzylphthalate	0.4 : 0.83	6 / 11	0.15	4.5	0.8868	0.8868	NA	NA
Chrysene	0.4 : 0.83	2 / 11	0.058	0.089	0.2897	0.089	400	No
Di-n-butylphthalate	0.43 : 1.3	4 / 11	0.032	32	4.427	4.427	NA	NA
Di-n-octylphthalate	0.4 : 0.79	7 / 11	0.059	0.38	0.1991	0.1991	NA	NA
Dibenzofuran	0.4 : 0.82	3 / 11	0.095	1.4	0.395	0.395	NA	NA
Fluoranthene	0.4 : 0.82	3 / 11	0.038	0.082	0.2547	0.082	10000	No
Hexachlorobenzene	0.4 : 0.83	1 / 11	0.24	0.24	0.3418	0.24	30	No
N-Nitrosodiphenylamine	0.76 : 0.79	9 / 11	0.15	3400	374.4477	374.448	NA	NA
Naphthalene	0.4 : 0.82	3 / 11	0.092	0.72	0.3375	0.3375	10000	No
Phenanthrene	0.4 : 0.82	5 / 11	0.052	0.69	0.3354	0.3354	10000	No
Phenol	0.4 : 0.82	3 / 11	0.055	0.25	0.2882	0.25	10000	No
Pyrene	0.4 : 0.82	6 / 11	0.057	0.2	0.2113	0.2	10000	No
bis(2-EthylHexyl)phthalate	0 : 0	11 / 11	0.97	6700	903.0609	903.061	10000	No
Pesticides/PCBs (mg/Kg)								
4,4'-DDD	0.035 : 0.04	1 / 7	0.04	0.04	0.0219	0.0219	100	No
Aldrin	0.018 : 0.02	1 / 7	0.032	0.032	0.0126	0.0126	1	No
Alpha-BHC	0.018 : 0.02	1 / 7	0.024	0.024	0.0115	0.0115	NA	NA
Endosulfan Sulfate	0.035 : 0.04	1 / 7	0.15	0.15	0.0376	0.0376	4000	No
Endrin	0.035 : 0.04	1 / 7	0.089	0.089	0.0289	0.0289	100	No
Metals (mg/Kg)								
Antimony	0.5 : 20	1 / 11	41	41	9.2755	9.2755	400	No
Arsenic	2.9 : 2.9	10 / 11	2.3	7.1	4.0136	4.0136	300	No
Barium	0 : 0	11 / 11	8.4	65	22.2909	22.2909	10000	No
Cadmium	1 : 1.1	1 / 11	1	1	0.55	0.55	800	No
Calcium	0 : 0	11 / 11	420	1400	794.5455	794.546	NA	NA
Chromium	0 : 0	11 / 11	68	17000	2316.091	2316.09	10000	No
Cobalt	3 : 3	8 / 11	1.6	4.4	2.6364	2.6364	NA	NA
Copper	0 : 0	11 / 11	3.4	16	8.8182	8.8182	NA	NA

TABLE 82
COMPARISON OF SUBSURFACE SOIL EPCs TO UCLs - LAKE POLY HOT SPOT

Olin Corporation
Wilmington, MA Facility

	Site Data/Concentration [2]						EPC [3]	UCL [4]	EPC Exceeds UCL?
OHM of Concern [1]	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean			
Cyanide	2	2	3 / 7	2.3	5.4	2	2	4000	No
Iron	0	0	11 / 11	4900	9900	7054.546	7054.55	NA	NA
Manganese	0	0	11 / 11	34	100	62.7273	62.7273	NA	NA
Mercury	0.1	0.15	4 / 11	0.1	0.52	0.1277	0.1277	600	No
Nickel	4	4	8 / 11	4.7	9.9	5.8091	5.8091	7000	No
Potassium	0	0	11 / 11	130	1300	639.0909	639.091	NA	NA
Sodium	0	0	11 / 11	23	200	101.1818	101.182	NA	NA
Vanadium	0	0	11 / 11	4.8	24	13.2818	13.2818	10000	No
Inorganics (mg/Kg)									
Chloride	40	40	2 / 11	98	100	34.3636	34.3636	NA	NA
Nitrogen, Ammonia	0	0	11 / 11	10	10000	1028.455	1028.45	NA	NA
Sulfate as SO4	20	80	6 / 11	40	260	65.0909	65.0909	NA	NA

Notes:

1 Selection of OHM of Concern for this medium is presented in Table 2.

2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
The median represents the median value of all sample results, including non-detects, with the SQL used as the value for non-detects.

3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.

4 UCL = Upper Concentration Limit in Soil (310 CMR 40.0996(5); 4/5/96)

EPC = Exposure Point Concentration

OHM = Oil or Hazardous Material

SQL = Sample Quantitation Limit

MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 83
COMPARISON OF SUBSURFACE SOIL EPCs TO UCLs - DRUM AREA B HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]	UCL [4]	EPC Exceeds UCL?
VOCs (mg/Kg)									
2-Butanone (MEK)	0.0027 :	2	1 / 3	0.0034	0.0034	0.3349	0.0034	10000	No
4-Methyl-2-Pentanone (MIBK)	0.0027 :	0.0029	1 / 3	1.5	1.5	0.5009	0.5009	10000	No
Acetone	0.0046 :	0.0046	2 / 3	0.25	690	230.0841	230.0841	10000	No
Benzene	0.0009 :	0.001	1 / 3	3.8	3.8	1.267	1.267	2000	No
Chlorobenzene	0.0009 :	0.001	1 / 3	0.86	0.86	0.287	0.287	10000	No
Ethylbenzene	0.0009 :	0.001	1 / 3	0.32	0.32	0.107	0.107	10000	No
Methylene Chloride	0.0018 :	0.156	1 / 3	0.69	0.69	0.2563	0.2563	7000	No
Toluene	0 :	0	3 / 3	0.0003	13	4.3336	4.3336	10000	No
Xylenes, Total	0.0009 :	0.001	1 / 3	1.7	1.7	0.567	0.567	10000	No
SVOCs (mg/Kg)									
1,2,3-Trichlorobenzene	0 :	0	1 / 1	1.4	1.4	1.4	1.4	NA	NA
1,2,4-Trichlorobenzene	0.99 :	0.99	1 / 2	0.35	0.35	0.4225	0.35	10000	No
1,2-Dichlorobenzene	0.99 :	0.99	2 / 3	0.84	4.7	2.0117	2.0117	5000	No
1,4-Dichlorobenzene	0.99 :	0.99	2 / 3	1.2	5.6	2.4317	2.4317	2000	No
2,4-Dimethylphenol	0.99 :	0.99	2 / 3	0.88	3.5	1.625	1.625	10000	No
2-Methylphenol (o-Cresol)	0.99 :	0.99	2 / 3	2.9	8	3.7983	3.7983	NA	NA
4-Methylphenol(p-Cresol)	0.99 :	0.99	2 / 3	3.6	8.8	4.2983	4.2983	NA	NA
Di-n-butylphthalate	1.3 :	1.3	2 / 3	0.12	0.23	0.3333	0.23	NA	NA
Di-n-octylphthalate	0.53 :	10	1 / 3	0.88	0.88	2.0483	0.88	NA	NA
Dibenzofuran	0.99 :	0.99	2 / 3	0.1	0.57	0.3883	0.3883	NA	NA
N-Nitrosodiphenylamine	0.99 :	10	1 / 3	1.5	1.5	2.3317	1.5	NA	NA
Naphthalene	0.99 :	0.99	2 / 3	4.1	5.7	3.4317	3.4317	10000	No
Phenol	0.53 :	0.99	1 / 3	510	510	170.2533	170.2533	10000	No
bis(2-EthylHexyl)phthalate	0 :	0	3 / 3	0.95	1100	367.8167	367.8167	10000	No
Pesticides/PCBs (mg/Kg)									
Endosulfan I	0.026 :	0.03	1 / 3	0.036	0.036	0.0213	0.0213	4000	No

TABLE 83
COMPARISON OF SUBSURFACE SOIL EPCs TO UCLs - DRUM AREA B HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]	UCL [4]	EPC Exceeds UCL?
Metals (mg/Kg)									
Arsenic	0.0044 :	0.0044	2 / 3	0.004	1.4	0.4687	0.4687	300	No
Barium	0 :	0	3 / 3	0.0014	6.2	2.0708	2.0708	10000	No
Cadmium	0.001 :	0.001	2 / 3	0.0026	1.3	0.4344	0.4344	800	No
Calcium	0 :	0	3 / 3	5	1900	688.3333	688.3333	NA	NA
Chromium	0 :	0	3 / 3	0.024	5.5	1.878	1.878	10000	No
Copper	0 :	0	3 / 3	0.005	18	6.0037	6.0037	NA	NA
Iron	0 :	0	3 / 3	2.6	1900	647.5333	647.5333	NA	NA
Manganese	0 :	0	3 / 3	0.049	18	6.053	6.053	NA	NA
Mercury	0.0002 :	0.1	1 / 3	0.0009	0.0009	0.017	0.0009	600	No
Nickel	0.004 :	0.004	1 / 3	25	25	8.3347	8.3347	7000	No
Potassium	0 :	0	3 / 3	0.05	220	73.4433	73.4433	NA	NA
Sodium	0 :	0	3 / 3	0.11	8600	2867.1033	2867.103	NA	NA
Vanadium	0 :	0	3 / 3	0.0099	35	11.674	11.674	10000	No
Inorganics (mg/Kg)									
Chloride	0.04 :	0.04	1 / 2	0.22	0.22	0.12	0.12	NA	NA
Nitrogen, Ammonia	0 :	0	2 / 2	0.047	0.1	0.0735	0.0735	NA	NA
Sulfate as SO4	0 :	0	2 / 2	350	29000	14675	14675	NA	NA

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 2.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
The median represents the median value of all sample results, including non-detects, with the SQL used as the value for non-detects.
3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.
4 UCL = Upper Concentration Limit in Soil (310 CMR 40.0996(5); 4/5/96)

TABLE 83
COMPARISON OF SUBSURFACE SOIL EPCs TO UCLs - DRUM AREA B HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern[1]	Site Data/Concentration[2]						EPC[3]	UCL[4]	EPC Exceeds UCL?
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean			

EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 84
COMPARISON OF SUBSURFACE SOIL EPCs TO UCLs - DRUM AREA A HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]	UCL [4]	EPC Exceeds UCL?
VOCs (mg/Kg)									
1,2-Dichloroethane	0.0007 :	0.7	1 / 7	0.082	0.082	0.1281	0.082	600	No
2,4,4-Trimethyl-1-pentene	0 :	0	3 / 3	0.68	360	120.52	120.52	NA	NA
2,4,4-Trimethyl-2-Pentene	0 :	0	3 / 3	0.19	93	31.2267	31.2267	NA	NA
2-Butanone (MEK)	0.002 :	2	2 / 7	0.04	0.099	0.3702	0.099	10000	No
2-Hexanone	0.002 :	2	3 / 7	0.6	3	0.9039	0.9039	NA	NA
4-Methyl-2-Pentanone (MIBK)	0.002 :	2	2 / 7	0.1	3	0.7611	0.7611	10000	No
Acetone	0.002 :	2	2 / 7	0.31	11	1.8075	1.8075	10000	No
Benzene	0.0007 :	0.9	1 / 7	0.035	0.035	0.175	0.035	2000	No
Carbon Disulfide	0.0013 :	1	2 / 7	0.5	3.4	0.6617	0.6617	NA	NA
Chlorobenzene	0.0007 :	0.9	1 / 7	0.041	0.041	0.1758	0.041	10000	No
Ethylbenzene	0.0007 :	0.7	2 / 7	0.14	0.9	0.215	0.215	10000	No
Methylene Chloride	0.0013 :	2	1 / 7	0.77	0.77	0.3515	0.3515	7000	No
Toluene	0.0007 :	0.0011	5 / 7	0.052	1.4	0.579	0.579	10000	No
Xylenes, Total	0.0007 :	0.15	3 / 7	0.093	1.1	0.3097	0.3097	10000	No
SVOCs (mg/Kg)									
4-Methylphenol(p-Cresol)	0.33 :	12	1 / 7	0.038	0.038	1.924	0.038	NA	NA
Butylbenzylphthalate	0.33 :	12	1 / 7	1.1	1.1	2.0757	1.1	NA	NA
Di-n-butylphthalate	0.33 :	12	1 / 7	3.1	3.1	2.1757	2.1757	NA	NA
Di-n-octylphthalate	0.33 :	12	1 / 7	0.2	0.2	1.9471	0.2	NA	NA
Indeno (1,2,3-cd)Pyrene	0.33 :	12	1 / 7	31	31	5.6614	5.6614	100	No
Isophorone	0.33 :	12	2 / 7	0.9	2.1	1.6329	1.6329	NA	NA
N-Nitrosodiphenylamine	1.2 :	12	5 / 7	5.4	21000	4746.143	4746.14	NA	NA
Naphthalene	0.33 :	12	1 / 7	0.077	0.077	1.9296	0.077	10000	No
Phenol	0.33 :	12	2 / 7	0.81	1	1.9629	1	10000	No
bis(2-EthylHexyl)phthalate	0.33 :	0.33	5 / 7	4.4	87	24.2471	24.2471	10000	No
Pesticides/PCBs (mg/Kg)									
Alpha-Chlordane	0.04 :	6.1	1 / 7	2	2	1.095	1.095	50	No
Methoxychlor	0.04 :	6.1	1 / 7	2	2	1.095	1.095	3000	No

TABLE 84
COMPARISON OF SUBSURFACE SOIL EPCs TO UCLs - DRUM AREA A HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]	UCL [4]	EPC Exceeds UCL?
Toxaphene	0.07 :	12	1 / 7	4	4	2.1821	2.1821	NA	NA
Metals (mg/Kg)									
Arsenic	0.0015 :	0.0034	5 / 7	0.0017	7.5	1.8583	1.8583	300	No
Barium	0.0005 :	0.0005	5 / 6	0.0036	49	10.2525	10.2525	10000	No
Cadmium	0.001 :	1	3 / 7	0.004	5.1	0.9722	0.9722	800	No
Calcium	0 :	0	7 / 7	0.11	61000	10814.38	10814.4	NA	NA
Chromium	0 :	0	7 / 7	0.0066	59	21.1728	21.1728	10000	No
Cobalt	0.0015 :	1.5	4 / 7	0.0016	8.7	1.7512	1.7512	NA	NA
Copper	0 :	0	7 / 7	0.0028	57	14.6183	14.6183	NA	NA
Iron	0 :	0	7 / 7	0.21	94000	16848.84	16848.8	NA	NA
Manganese	0 :	0	7 / 7	0.0034	460	94.3222	94.3222	NA	NA
Mercury	0.0001 :	0.15	2 / 7	0.0002	0.0002	0.0258	0.0002	600	No
Nickel	0 :	0	7 / 7	0.0046	30	9.1515	9.1515	7000	No
Potassium	0 :	0	7 / 7	0.0035	680	224.0016	224.002	NA	NA
Sodium	0 :	0	7 / 7	0.023	530	119.7781	119.778	NA	NA
Vanadium	0.0025 :	0.0026	4 / 7	0.007	27	7.8444	7.8444	10000	No
Inorganics (mg/Kg)									
Chloride	0 :	0	4 / 4	0.92	25	11.78	11.78	NA	NA
Nitrogen, Ammonia	0 :	0	4 / 4	0.02	2.1	0.5975	0.5975	NA	NA
Sulfate as SO4	0 :	0	2 / 2	600	5600	3100	3100	NA	NA

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 2.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
The median represents the median value of all sample results, including non-detects, with the SQL used as the value for non-detects.
3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum

TABLE 84
COMPARISON OF SUBSURFACE SOIL EPCs TO UCLs - DRUM AREA A HOT SPOT

Olin Corporation
Wilmington, MA Facility

	Site Data/Concentration [2]								
OHM of Concern [1]	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]	UCL [4]	EPC Exceeds UCL?

detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.
4 UCL = Upper Concentration Limit in Soil (310 CMR 40.0996(5); 4/5/96)
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 85
COMPARISON OF SUBSURFACE SOIL EPCs TO UCLs - FORMER LAGOON AREA HOT SPOT

Olin Corporation
Wilmington, MA Facility

	Site Data/Concentration [2]								
OHM of Concern [1]	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]	UCL [4]	EPC Exceeds UCL?
VOCs (mg/Kg)									
2,4,4-Trimethyl-1-pentene	0.011 :	0.011	4 / 9	0.002	3.3	0.3758	0.3758	NA	NA
2,4,4-Trimethyl-2-Pentene	0.011 :	0.011	5 / 9	0.001	0.91	0.1067	0.1067	NA	NA
2-Butanone (MEK)	0.016 :	0.082	4 / 10	0.001	0.49	0.0577	0.0577	10000	No
2-Hexanone	0.016 :	2	1 / 10	0.061	0.061	0.1192	0.061	NA	NA
Acetone	0.016 :	0.019	5 / 10	0.041	17	1.8174	1.8174	10000	No
Benzene	0.0055 :	0.028	1 / 10	0.1	0.1	0.0148	0.0148	2000	No
Chloroform	0.0055 :	0.7	1 / 10	0.002	0.002	0.0397	0.002	5000	No
Methylene Chloride	0.011 :	0.055	1 / 10	2	2	0.2094	0.2094	7000	No
Tetrachloroethene (PCE)	0.0055 :	0.7	1 / 10	0.001	0.001	0.0396	0.001	1000	No
Toluene	0.0055 :	0.028	4 / 10	0.001	0.15	0.0192	0.0192	10000	No
Trichloroethene (TCE)	0.0055 :	0.028	1 / 10	0.08	0.08	0.0128	0.0128	5000	No
SVOCs (mg/Kg)									
1,2,4-Trichlorobenzene	0.69 :	0.76	2 / 10	0.075	0.086	0.3091	0.086	10000	No
Anthracene	0.73 :	0.79	1 / 10	0.028	0.028	0.3373	0.028	10000	No
Benzo(a)Anthracene	0.73 :	0.79	1 / 10	0.08	0.08	0.3425	0.08	100	No
Benzo(a)Pyrene	0.73 :	0.79	1 / 10	0.055	0.055	0.34	0.055	100	No
Benzo(b)Fluoranthene	0.73 :	0.79	1 / 10	0.084	0.084	0.3429	0.084	100	No
Butylbenzylphthalate	0.69 :	0.76	1 / 10	0.035	0.035	0.333	0.035	NA	NA
Chrysene	0.73 :	0.79	1 / 10	0.086	0.086	0.3431	0.086	400	No
Di-n-octylphthalate	0.69 :	0.79	3 / 10	0.014	0.073	0.2727	0.073	NA	NA
Fluoranthene	0.73 :	0.79	1 / 10	0.16	0.16	0.3505	0.16	10000	No
N-Nitrosodiphenylamine	0.69 :	0.76	5 / 10	0.15	0.98	0.397	0.397	NA	NA
Naphthalene	0.69 :	0.76	1 / 10	0.63	0.63	0.3925	0.3925	10000	No
Phenanthrene	0.73 :	0.79	1 / 10	0.12	0.12	0.3465	0.12	10000	No
Phenol	0.69 :	0.76	2 / 10	0.075	0.1	0.3105	0.1	10000	No
Pyrene	0.73 :	0.79	1 / 10	0.13	0.13	0.3475	0.13	10000	No
bis(2-EthylHexyl)phthalate	0.69 :	1.4	6 / 10	1.7	27	4.862	4.862	10000	No

TABLE 85
COMPARISON OF SUBSURFACE SOIL EPCs TO UCLs - FORMER LAGOON AREA HOT SPOT

Olin Corporation
Wilmington, MA Facility

	Site Data/Concentration [2]								
OHM of Concern [1]	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]	UCL [4]	EPC Exceeds UCL?
Pesticides/PCBs (mg/Kg)									
Endrin Ketone	0.034 :	0.038	1 / 10	0.045	0.045	0.0204	0.0204	NA	NA
Gamma-BHC (Lindane)	0.017 :	0.019	1 / 10	0.048	0.048	0.0129	0.0129	20	No
Metals (mg/Kg)									
Arsenic	0 :	0	10 / 10	1.1	21	10.2	10.2	300	No
Barium	0 :	0	10 / 10	6.6	39	25.66	25.66	10000	No
Cadmium	1 :	1	6 / 10	1.2	1.8	1.02	1.02	800	No
Calcium	0 :	0	10 / 10	1600	16000	5180	5180	NA	NA
Chromium	0 :	0	10 / 10	7.3	160	46.03	46.03	10000	No
Cobalt	1.5 :	1.5	9 / 10	1.8	7.2	4.025	4.025	NA	NA
Copper	2.5 :	2.5	9 / 10	4	47	12.825	12.825	NA	NA
Iron	0 :	0	10 / 10	840	15000	9764	9764	NA	NA
Manganese	0 :	0	10 / 10	7.6	320	156.56	156.56	NA	NA
Nickel	4 :	4	9 / 10	4.8	18	10.94	10.94	7000	No
Potassium	0 :	0	10 / 10	160	2100	1263	1263	NA	NA
Sodium	0 :	0	10 / 10	67	240	121.1	121.1	NA	NA
Vanadium	1.5 :	1.5	9 / 10	5.9	21	13.665	13.665	10000	No
Inorganics (mg/Kg)									
Chloride	40 :	40	5 / 10	57	100	47.8	47.8	NA	NA
Nitrogen, Ammonia	0 :	0	10 / 10	8.4	210	68.34	68.34	NA	NA
Sulfate as SO4	0 :	0	10 / 10	210	33000	6199	6199	NA	NA

Notes:

1 Selection of OHM of Concern for this medium is presented in Table 2.

2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.

TABLE 85
COMPARISON OF SUBSURFACE SOIL EPCs TO UCLs - FORMER LAGOON AREA HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]	UCL [4]	EPC Exceeds UCL?

The median represents the median value of all sample results, including non-detects, with the SQL used as the value for non-detects.

3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.

4 UCL = Upper Concentration Limit in Soil (310 CMR 40.0996(5); 4/5/96)

EPC = Exposure Point Concentration

OHM = Oil or Hazardous Material

SQL = Sample Quantitation Limit

MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 86
COMPARISON OF SUBSURFACE SOIL EPCs TO UCLs - PLANT B AREA HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]	UCL [4]	EPC Exceeds UCL?
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean			
VOCs (mg/Kg)									
1,2-Dichloroethane	0.0055 :	0.0055	1 / 4	0.035	0.035	0.0108	0.0108	600	No
2,4,4-Trimethyl-1-pentene	0 :	0	5 / 5	0.028	1.7	0.7236	0.7236	NA	NA
2,4,4-Trimethyl-2-Pentene	0 :	0	5 / 5	0.015	0.72	0.2576	0.2576	NA	NA
2-Butanone (MEK)	0.016 :	0.016	2 / 4	0.006	0.017	0.0098	0.0098	10000	No
2-Hexanone	0.016 :	0.016	3 / 5	0.026	0.078	0.0378	0.0378	NA	NA
4-Methyl-2-Pentanone (MIBK)	0.016 :	0.016	1 / 4	0.027	0.027	0.0128	0.0128	10000	No
Acetone	0.016 :	0.017	1 / 4	0.09	0.09	0.0286	0.0286	10000	No
Carbon Tetrachloride	0.0055 :	0.0055	1 / 4	0.009	0.009	0.0043	0.0043	400	No
Chlorobenzene	0.0055 :	0.0055	1 / 4	0.017	0.017	0.0063	0.0063	10000	No
Chloroform	0.0055 :	0.0055	1 / 4	0.007	0.007	0.0038	0.0038	5000	No
Ethylbenzene	0.0055 :	0.029	1 / 5	0.002	0.002	0.005	0.002	10000	No
Tetrachloroethene (PCE)	0.0055 :	0.0055	4 / 5	0.0008	0.014	0.0039	0.0039	1000	No
Toluene	0.0055 :	0.0055	2 / 4	0.0008	0.03	0.0091	0.0091	10000	No
Trichloroethene (TCE)	0.0055 :	0.0055	1 / 4	0.022	0.022	0.0076	0.0076	5000	No
Xylenes, Total	0.0055 :	0.0055	1 / 4	0.085	0.085	0.0233	0.0233	10000	No
SVOCs (mg/Kg)									
Di-n-octylphthalate	0 :	0	5 / 5	0.1	0.37	0.252	0.252	NA	NA
Indeno (1,2,3-cd)Pyrene	0.69 :	0.96	2 / 5	0.28	0.96	0.486	0.486	100	No
N-Nitrosodiphenylamine	0.69 :	0.96	2 / 4	0.33	0.36	0.3788	0.36	NA	NA
Pyrene	0.69 :	0.73	1 / 4	0.14	0.14	0.3038	0.14	10000	No
bis(2-EthylHexyl)phthalate	0 :	0	5 / 5	210	1200	602	602	10000	No
Metals (mg/Kg)									
Arsenic	0 :	0	5 / 5	0.9	5.5	3.82	3.82	300	No
Barium	0 :	0	5 / 5	5.6	12	7.1	7.1	10000	No
Calcium	0 :	0	5 / 5	400	5900	1814	1814	NA	NA
Chromium	0 :	0	5 / 5	4.2	6.6	5.9	5.9	10000	No
Cobalt	1.5 :	1.5	2 / 4	1.9	3	1.6	1.6	NA	NA

TABLE 86
COMPARISON OF SUBSURFACE SOIL EPCs TO UCLs - PLANT B AREA HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]	UCL [4]	EPC Exceeds UCL?
Copper	2.5 :	2.5	4 / 5	2.6	6	3.09	3.09	NA	NA
Iron	0 :	0	5 / 5	2100	5900	4000	4000	NA	NA
Manganese	0 :	0	5 / 5	30	59	37.6	37.6	NA	NA
Nickel	4 :	4	3 / 4	4.1	5.5	3.975	3.975	7000	No
Potassium	0 :	0	5 / 5	380	700	492	492	NA	NA
Sodium	0 :	0	5 / 5	26	130	78.4	78.4	NA	NA
Vanadium	2.5 :	2.5	4 / 5	4.2	8.6	4.91	4.91	10000	No
Inorganics (mg/Kg)									
Chloride	40 :	40	1 / 4	56	56	29	29	NA	NA
Nitrogen, Ammonia	8 :	8	1 / 4	10	10	5.5	5.5	NA	NA
Sulfate as SO4	20 :	20	4 / 5	22	120	47.6	47.6	NA	NA

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 2.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
The median represents the median value of all sample results, including non-detects, with the SQL used as the value for non-detects.
3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.
4 UCL = Upper Concentration Limit in Soil (310 CMR 40.0996(5); 4/5/96)
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 87
COMPARISON OF SUBSURFACE SOIL EPCs TO UCLs - SULFATE LANDFILL

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]	UCL [4]	EPC Exceeds UCL?
SVOCs (mg/Kg)									
bis(2-EthylHexyl)phthalate	0 : 0		1 / 1	1.2	1.2	1.2	1.2	10000	No
Metals (mg/Kg)									
Arsenic	0 : 0		1 / 1	0.0062	0.0062	0.0062	0.0062	300	No
Barium	0 : 0		1 / 1	0.015	0.015	0.015	0.015	10000	No
Calcium	0 : 0		1 / 1	6.9	6.9	6.9	6.9	NA	NA
Chromium	0 : 0		1 / 1	0.01	0.01	0.01	0.01	10000	No
Cobalt	0 : 0		1 / 1	0.0021	0.0021	0.0021	0.0021	NA	NA
Copper	0 : 0		1 / 1	0.0082	0.0082	0.0082	0.0082	NA	NA
Iron	0 : 0		1 / 1	6.9	6.9	6.9	6.9	NA	NA
Manganese	0 : 0		1 / 1	0.06	0.06	0.06	0.06	NA	NA
Nickel	0 : 0		1 / 1	0.0062	0.0062	0.0062	0.0062	7000	No
Potassium	0 : 0		1 / 1	0.25	0.25	0.25	0.25	NA	NA
Sodium	0 : 0		1 / 1	0.27	0.27	0.27	0.27	NA	NA
Vanadium	0 : 0		1 / 1	0.013	0.013	0.013	0.013	10000	No
Inorganics (mg/Kg)									
Chloride	0 : 0		1 / 1	0.36	0.36	0.36	0.36	NA	NA
Nitrogen, Ammonia	0 : 0		1 / 1	0.64	0.64	0.64	0.64	NA	NA
Sulfate as SO4	0 : 0		1 / 1	28000	28000	28000	28000	NA	NA

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 2.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
The median represents the median value of all sample results, including non-detects, with the SQL used as the value for non-detects.

TABLE 87
COMPARISON OF SUBSURFACE SOIL EPCs TO UCLs - SULFATE LANDFILL

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]	UCL [4]	EPC Exceeds UCL?
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean			

3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.

4 UCL = Upper Concentration Limit in Soil (310 CMR 40.0996(5); 4/5/96)

EPC = Exposure Point Concentration

OHM = Oil or Hazardous Material

SQL = Sample Quantitation Limit

MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 88
COMPARISON OF SUBSURFACE SOIL EPCs TO UCLs - SITE AREA
(EXCLUDING HOT SPOTS AND SULFATE LANDFILL)

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]	UCL [4]	EPC Exceeds UCL?
VOCs (mg/Kg)									
2,4,4-Trimethyl-1-pentene	0.01 :	0.011	18 / 21	0.003	7	0.6929	0.6929	NA	NA
2,4,4-Trimethyl-2-Pentene	0.01 :	0.012	15 / 21	0.002	5.1	0.4963	0.4963	NA	NA
2-Butanone (MEK)	0.015 :	0.021	9 / 22	0.0006	0.01	0.0061	0.0061	10000	No
2-Hexanone	0.0027 :	0.1	7 / 22	0.001	3.8	0.1843	0.1843	NA	NA
4-Methyl-2-Pentanone (MIBK)	0.0027 :	0.1	2 / 22	0.005	0.015	0.0101	0.0101	10000	No
Acetone	0.0027 :	0.1	3 / 22	0.016	0.12	0.017	0.017	10000	No
Benzene	0.0009 :	0.007	2 / 22	0.0005	0.012	0.003	0.003	2000	No
Carbon Disulfide	0.0018 :	0.07	1 / 22	0.001	0.001	0.0065	0.001	NA	NA
Chloroform	0.0009 :	0.035	1 / 22	0.001	0.001	0.0033	0.001	5000	No
Ethylbenzene	0.005 :	0.007	4 / 22	0.0019	2.3	0.1075	0.1075	10000	No
Styrene	0.0009 :	0.035	3 / 22	0.0005	3.3	0.1531	0.1531	1000	No
Tetrachloroethene (PCE)	0.0009 :	0.035	3 / 22	0.0008	0.001	0.0031	0.001	1000	No
Toluene	0.005 :	0.007	14 / 22	0.0005	4.8	0.2208	0.2208	10000	No
Trichloroethene (TCE)	0.0009 :	0.007	1 / 22	0.01	0.01	0.003	0.003	5000	No
Xylenes, Total	0.005 :	0.035	2 / 22	0.0011	0.035	0.0049	0.0049	10000	No
SVOCs (mg/Kg)									
Benzo(a)Anthracene	0.012 :	1.2	1 / 19	0.048	0.048	0.3473	0.048	100	No
Benzo(b)Fluoranthene	0.012 :	1.2	1 / 19	0.049	0.049	0.3474	0.049	100	No
Butylbenzylphthalate	0.012 :	0.92	3 / 19	0.05	0.13	0.3019	0.13	NA	NA
Chrysene	0.012 :	1.2	1 / 19	0.057	0.057	0.3478	0.057	400	No
Di-n-octylphthalate	0.012 :	1.2	3 / 19	0.023	0.31	0.3378	0.31	NA	NA
Diethylphthalate	0.012 :	1.2	2 / 19	0.046	0.057	0.326	0.057	10000	No
N-Nitroso-di-n-propylamine	0.69 :	1.2	1 / 19	1.6	1.6	0.4468	0.4468	NA	NA
N-Nitrosodiphenylamine	0.012 :	1.2	1 / 19	0.41	0.41	0.3664	0.3664	NA	NA
Phenol	0.69 :	1.2	1 / 19	5.3	5.3	0.6416	0.6416	10000	No
Pyrene	0.012 :	1.2	2 / 19	0.043	0.17	0.3368	0.17	10000	No
bis(2-EthylHexyl)phthalate	0.012 :	2.5	10 / 21	0.1	3.4	0.8379	0.8379	10000	No

TABLE 88
COMPARISON OF SUBSURFACE SOIL EPCs TO UCLs - SITE AREA
(EXCLUDING HOT SPOTS AND SULFATE LANDFILL)

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	EPC [3]	UCL [4]	EPC Exceeds UCL?
Metals (mg/Kg)									
Arsenic	2 :	2	18 / 19	0.0046	18	5.7318	5.7318	300	No
Barium	0 :	0	20 / 20	0.09	75	16.8645	16.8645	10000	No
Cadmium	1 :	1	5 / 19	0.0048	1.3	0.6003	0.6003	800	No
Calcium	0 :	0	20 / 20	1.2	1900	728.06	728.06	NA	NA
Chromium	0 :	0	20 / 20	0.028	230	29.7864	29.7864	10000	No
Cobalt	1.5 :	1.5	15 / 20	0.0017	4.1	1.9926	1.9926	NA	NA
Copper	2.5 :	2.5	17 / 20	0.0056	14	4.9728	4.9728	NA	NA
Iron	0 :	0	20 / 20	6.8	12000	6194.34	6194.34	NA	NA
Manganese	0 :	0	20 / 20	0.044	340	71.1872	71.1872	NA	NA
Mercury	0.1 :	0.13	1 / 18	0.0001	0.0001	0.0483	0.0001	600	No
Nickel	4 :	4	15 / 19	0.0047	11	5.1476	5.1476	7000	No
Potassium	0 :	0	20 / 20	0.26	1800	739.013	739.013	NA	NA
Silver	0.0015 :	1.5	1 / 18	4.5	4.5	0.9167	0.9167	2000	No
Sodium	0 :	0	20 / 20	0.25	440	88.4625	88.4625	NA	NA
Inorganics (mg/Kg)									
Chloride	40 :	40	9 / 18	0.26	170	44.5144	44.5144	NA	NA
Nitrogen, Ammonia	8 :	8	15 / 19	0.49	400	45.8311	45.8311	NA	NA
Sulfate as SO4	20 :	27	13 / 20	23	360	74.475	74.475	NA	NA

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 2.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
The median represents the median value of all sample results, including non-detects, with the SQL used as the value for non-detects.
3 The EPC is the arithmetic mean concentration unless the arithmetic mean concentration exceeds the maximum

TABLE 88
COMPARISON OF SUBSURFACE SOIL EPCs TO UCLs - SITE AREA
(EXCLUDING HOT SPOTS AND SULFATE LANDFILL)

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2]						EPC [3]	UCL [4]	EPC Exceeds UCL?
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean			

detected concentration (MADEP, 1995). For these OHM, the maximum detected concentration is used as the EPC.
4 UCL = Upper Concentration Limit in Soil (310 CMR 40.0996(5); 4/5/96)
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 89
COMPARISON OF NON-ZONE II GROUNDWATER EPCs TO UCLs
SHALLOW GROUNDWATER HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM of Concern [1]	Site Data/Concentration [2] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Groundwater EPC [3]	UCL [4]	EPC Exceeds UCL?
VOCs (mg/L)									
1,1,1-Trichloroethane	0.005 :	0.01	2 / 19	0.002	0.019	0.0035	0.0035	100	No
1,1-Dichloroethane	0.005 :	0.01	3 / 19	0.0008	0.006	0.0027	0.0027	100	No
2,4,4-Trimethyl-1-pentene	0.005 :	0.01	12 / 22	0.002	0.93	0.0622	0.0622	NA	NA
2,4,4-Trimethyl-2-Pentene	0.005 :	0.01	10 / 22	0.0007	0.38	0.0263	0.0263	NA	NA
4-Methyl-2-Pentanone (MIBK)	0.01 :	0.02	1 / 19	0.026	0.026	0.0078	0.0078	100	No
Acetone	0.01 :	0.027	9 / 19	0.008	2	0.1391	0.1391	100	No
Bromoform	0.005 :	0.01	3 / 19	0.002	0.022	0.0038	0.0038	100	No
Carbon Disulfide	0.005 :	0.01	1 / 19	0.009	0.009	0.0044	0.0044	NA	NA
Dibromochloromethane	0.005 :	0.01	2 / 19	0.002	0.007	0.0028	0.0028	100	No
Methylene Chloride	0.005 :	0.01	3 / 19	0.0008	0.002	0.0039	0.0039	100	No

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 3.
2 Samples included in Site Data set are presented in "Data Used in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
3 The EPC is the maximum detected concentration.
4 UCL = Upper Concentration Limit in Groundwater (310 CMR 40.0996(5); 4/5/96)
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).
NA = Not Available

TABLE 90
COMPARISON OF NON-ZONE II GROUNDWATER EPCs TO UCLs
DENSE LAYER HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM	Site Data/Concentration [1]						Groundwater EPC [3]	UCL [4]	EPC Exceeds UCL?
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean			
VOCs (mg/L)									
1,1,1-Trichloroethane	0.005 :	0.05	6 / 16	0.002	0.011	0.0064	0.0064	100	No
1,1-Dichloroethane	0.005 :	0.05	4 / 16	0.002	0.005	0.0049	0.0049	100	No
1,1-Dichloroethene	0.005 :	0.05	3 / 16	0.001	0.002	0.0045	0.002	100	No
1,2-Dichloroethane	0.005 :	0.05	14 / 16	0.002	0.027	0.0133	0.0133	100	No
2,4,4-Trimethyl-1-pentene	0.01 :	0.1	5 / 16	0.002	0.049	0.0133	0.0133	NA	NA
2,4,4-Trimethyl-2-Pentene	0.01 :	0.1	3 / 17	0.003	0.013	0.0121	0.0121	NA	NA
2-Butanone (MEK)	0.012 :	0.2	4 / 15	0.003	0.052	0.0188	0.0188	100	No
2-Hexanone	0.015 :	0.2	2 / 16	0.16	0.16	0.0345	0.0345	NA	NA
4-Methyl-2-Pentanone (MIBK)	0.015 :	0.2	3 / 16	0.001	0.004	0.0144	0.004	100	No
Acetone	0.015 :	0.3	12 / 16	0.04	0.92	0.207	0.207	100	No
Benzene	0.005 :	0.05	5 / 16	0.002	0.004	0.0048	0.004	70	No
Bromodichloromethane	0.005 :	0.05	12 / 16	0.002	0.043	0.0155	0.0155	100	No
Bromoform	0.005 :	0.005	15 / 16	0.002	0.75	0.1667	0.1667	100	No
Carbon Disulfide	0.01 :	0.1	14 / 16	0.003	0.051	0.0194	0.0194	NA	NA
Carbon Tetrachloride	0.005 :	0.05	5 / 16	0.001	0.016	0.0059	0.0059	100	No
Chloroform	0.005 :	0.005	15 / 16	0.002	0.094	0.0317	0.0317	100	No
Chloromethane(MethylChloride)	0.01 :	0.1	6 / 16	0.001	0.006	0.009	0.006	100	No
Dibromochloromethane	0.005 :	0.05	13 / 16	0.003	0.17	0.0439	0.0439	100	No
Ethylbenzene	0.005 :	0.05	5 / 16	0.001	0.006	0.0049	0.0049	100	No
Methylene Chloride	0.008 :	0.1	6 / 16	0.003	0.013	0.0107	0.0107	100	No
Tetrachloroethene (PCE)	0.005 :	0.05	2 / 16	0.002	0.078	0.0095	0.0095	50	No
Toluene	0.005 :	0.005	14 / 16	0.008	0.081	0.0366	0.0366	100	No
Trichloroethene (TCE)	0.005 :	0.05	11 / 16	0.002	0.016	0.0051	0.0051	100	No
Xylenes, Total	0.005 :	0.05	3 / 16	0.001	0.007	0.0053	0.0053	100	No

TABLE 90
COMPARISON OF NON-ZONE II GROUNDWATER EPCs TO UCLs
DENSE LAYER HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM	Site Data/Concentration [1] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Groundwater EPC [3]	UCL [4]	EPC Exceeds UCL?
SVOCs (mg/L)									
1,2,4-Trichlorobenzene	0.01 :	0.01	3 / 15	0.001	0.007	0.0047	0.0047	50	No
1,2-Dichlorobenzene	0.01 :	0.01	1 / 15	0.002	0.002	0.0048	0.002	100	No
1,4-Dichlorobenzene	0.01 :	0.01	1 / 15	0.003	0.003	0.0049	0.003	40	No
2,4-Dichlorophenol	0.01 :	0.01	5 / 13	0.001	0.003	0.0037	0.003	40	No
2,6-Dinitrotoluene	0.01 :	0.01	1 / 15	0.005	0.005	0.005	0.005	NA	NA
2-Chlorophenol	0.01 :	0.01	6 / 14	0.001	0.003	0.0036	0.003	100	No
2-Methylphenol (o-Cresol)	0.01 :	0.01	9 / 14	0.002	0.02	0.0055	0.0055	NA	NA
2-Nitrophenol	0.01 :	0.01	13 / 14	0.001	0.21	0.082	0.082	NA	NA
4-Bromophenyl-phenylether	0.01 :	0.01	8 / 15	0.001	0.034	0.0067	0.0067	NA	NA
4-Chlorophenyl-phenylether	0.01 :	0.01	3 / 15	0.002	0.015	0.0053	0.0053	NA	NA
4-Methylphenol(p-Cresol)	0.01 :	0.01	10 / 15	0.002	0.081	0.0189	0.0189	NA	NA
4-Nitrophenol	0 :	0	15 / 15	0.003	0.33	0.1177	0.1177	NA	NA
Benzoic Acid	0.05 :	0.05	7 / 15	0.002	0.043	0.0209	0.0209	NA	NA
Benzyl Alcohol	0.01 :	0.01	8 / 15	0.002	0.009	0.0048	0.0048	NA	NA
Di-n-butylphthalate	0.01 :	0.01	3 / 16	0.0004	0.009	0.0048	0.0048	NA	NA
Dibenzofuran	0.01 :	0.01	2 / 15	0.001	0.002	0.0045	0.002	NA	NA
Isophorone	0.01 :	0.01	4 / 15	0.002	0.008	0.0047	0.0047	NA	NA
N-Nitrosodiphenylamine	0.01 :	0.01	5 / 16	0.001	0.005	0.0043	0.0043	NA	NA
Naphthalene	0.01 :	0.01	15 / 16	0.0002	0.088	0.0266	0.0266	20	No
Phenol	0.01 :	0.01	13 / 16	0.003	1.2	0.3474	0.3474	100	No
bis(2-EthylHexyl)phthalate	0.01 :	0.01	5 / 16	0.001	0.006	0.0044	0.0044	0.7	No
Pesticides/PCBs (mg/L)									
Alpha-BHC	0.00005 :	0.0005	9 / 15	0.000094	0.0003	0.000137	0.000137	NA	NA
Beta-BHC	0.00005 :	0.0005	4 / 15	0.000059	0.00012	0.0000792	0.0000792	NA	NA
Delta-BHC	0.00005 :	0.0005	1 / 15	0.0027	0.0027	0.000227	0.000227	NA	NA

TABLE 90
COMPARISON OF NON-ZONE II GROUNDWATER EPCs TO UCLs
DENSE LAYER HOT SPOT

Olin Corporation
Wilmington, MA Facility

OHM	Site Data/Concentration [1]						Groundwater EPC [3]	UCL [4]	EPC Exceeds UCL?
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean			
Gamma-BHC (Lindane)	0.00005	0.0005	2 / 14	0.000058	0.000085	0.0000727	0.0000727	0.008	No
Heptachlor Epoxide	0.00005	0.0005	1 / 15	0.000051	0.000051	0.0000651	0.000051	0.02	No
Metals (mg/L)									
Aluminum	0	0	5 / 5	43	2400	1036.6	1036.6	NA	NA
Barium	0.05	0.1	2 / 5	0.14	0.19	0.086	0.086	100	No
Beryllium	0.015	0.015	1 / 2	0.084	0.084	0.0458	0.0458	0.5	No
Cadmium	0	0	2 / 2	0.022	0.19	0.106	0.106	0.1	Yes
Calcium	0	0	5 / 5	290	590	378	378	NA	NA
Chromium	0	0	12 / 12	0.52	2800	751.2267	751.2267	20	Yes
Cobalt	0	0	2 / 2	0.32	3	1.66	1.66	NA	NA
Copper	0	0	2 / 2	0.13	2.8	1.465	1.465	NA	NA
Cyanide	0.02	0.02	1 / 2	0.026	0.026	0.018	0.018	2	No
Iron	0	0	5 / 5	440	3600	1448	1448	NA	NA
Lead	0.05	0.25	2 / 5	0.087	0.17	0.0914	0.0914	0.3	No
Magnesium	0	0	5 / 5	96	1600	685.2	685.2	NA	NA
Manganese	0	0	5 / 5	13	580	205.8	205.8	NA	NA
Mercury	0.0002	0.0002	1 / 2	0.0009	0.0009	0.0005	0.0005	0.02	No
Nickel	0	0	2 / 2	0.19	4.2	2.195	2.195	1	Yes
Potassium	0	0	5 / 5	16	110	57	57	NA	NA
Sodium	0	0	5 / 5	1700	22000	10880	10880	NA	NA
Vanadium	0	0	2 / 2	0.1	1.4	0.75	0.75	20	No
Zinc	0	0	2 / 2	0.24	14	7.12	7.12	20	No
Inorganics (mg/L)									
Chloride	0	0	31 / 31	820	91000	13316.7742	13316.7742	NA	NA
Nitrate as N	0	0	5 / 5	3.1	22	14.42	14.42	NA	NA
Nitrite as N	0.05	0.05	3 / 4	0.17	0.33	0.1763	0.1763	NA	NA
Nitrogen, Ammonia	0	0	35 / 35	0.81	7000	1542.0089	1542.0089	NA	NA

TABLE 90
COMPARISON OF NON-ZONE II GROUNDWATER EPCs TO UCLs
DENSE LAYER HOT SPOT

Olin Corporation
Wilmington, MA Facility

	Site Data/Concentration [1]								
OHM	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Groundwater EPC [3]	UCL [4]	EPC Exceeds UCL?
Sulfate as SO4	0 :	0	32 / 32	3700	87000	39853.125	39853.125	NA	NA

Notes:

1 Selection of OHM of Concern for this medium is presented in Table 3.

2 Samples included in Site Data set are presented in "Data Used in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.

3 The EPC is the arithmetic mean concentration unless the maximum detected concentration is less than the mean concentration, in which case the maximum detected concentration is the EPC.

4 UCL = Upper Concentration Limit in Groundwater (310 CMR 40.0996(5); 4/5/96)

EPC = Exposure Point Concentration

OHM = Oil or Hazardous Material

SQL = Sample Quantitation Limit

MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

NA = Not Available

TABLE 91
COMPARISON OF NON-ZONE II GROUNDWATER EPCs TO UCLs
GROUNDWATER EXCLUDING HOT SPOTS

Olin Corporation
Wilmington, MA Facility

OHM	Site Data/Concentration [1]						Groundwater EPC [3]	UCL [4]	EPC Exceeds UCL?
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean			
VOCs (mg/L)									
1,1,1-Trichloroethane	0.005 :	0.005	2 / 43	0.001	0.002	0.0025	0.002	100	No
1,1-Dichloroethane	0.005 :	0.3	2 / 43	0.003	0.004	0.006	0.004	100	No
1,2-Dichloroethane	0.005 :	0.005	1 / 43	0.004	0.004	0.0025	0.0025	100	No
2,4,4-Trimethyl-1-pentene	0.005 :	0.01	12 / 46	0.003	0.42	0.0263	0.0263	NA	NA
2,4,4-Trimethyl-2-Pentene	0.005 :	0.01	10 / 46	0.002	0.13	0.0114	0.0114	NA	NA
Acetone	0.01 :	0.027	17 / 43	0.001	13	0.4764	0.4764	100	No
Bromoform	0.005 :	0.005	2 / 43	0.002	0.007	0.0026	0.0026	100	No
Carbon Disulfide	0.005 :	0.01	1 / 43	0.003	0.003	0.0047	0.003	NA	NA
Carbon Tetrachloride	0.005 :	0.005	1 / 41	0.008	0.008	0.0026	0.0026	100	No
Chloroform	0.005 :	0.005	1 / 43	0.005	0.005	0.0026	0.0026	100	No
Methylene Chloride	0.002 :	0.01	5 / 42	0.002	0.003	0.0043	0.003	100	No
Tetrachloroethene (PCE)	0.002 :	0.005	3 / 43	0.001	0.001	0.0024	0.001	50	No
Toluene	0.005 :	0.005	2 / 43	0.001	0.002	0.0025	0.002	100	No
Trichloroethene (TCE)	0.005 :	0.005	1 / 43	0.008	0.008	0.0026	0.0026	100	No
Xylenes, Total	0.005 :	0.005	1 / 43	0.001	0.001	0.0025	0.001	100	No
SVOCs (mg/L)									
1,2,4-Trichlorobenzene	0.01 :	0.012	1 / 39	0.002	0.002	0.005	0.002	50	No
1,2-Dichlorobenzene	0.01 :	0.012	2 / 39	0.003	0.003	0.0049	0.003	100	No
1,3-Dichlorobenzene	0.01 :	0.012	2 / 39	0.001	0.001	0.0048	0.001	100	No
1,4-Dichlorobenzene	0.01 :	0.012	2 / 39	0.003	0.003	0.0049	0.003	40	No
2,6-Dinitrotoluene	0.01 :	0.012	1 / 39	0.001	0.001	0.0049	0.001	NA	NA
2-Nitrophenol	0.01 :	0.012	2 / 39	0.001	0.01	0.0051	0.0051	NA	NA
4-Bromophenyl-phenylether	0.01 :	0.012	1 / 39	0.006	0.006	0.0051	0.0051	NA	NA
4-Chlorophenyl-phenylether	0.01 :	0.012	2 / 38	0.001	0.004	0.0049	0.004	NA	NA
4-Nitrophenol	0.025 :	0.06	6 / 39	0.001	0.013	0.0119	0.0119	NA	NA
Benzoic Acid	0.05 :	0.06	2 / 39	0.001	0.006	0.024	0.006	NA	NA

TABLE 91
COMPARISON OF NON-ZONE II GROUNDWATER EPCs TO UCLs
GROUNDWATER EXCLUDING HOT SPOTS

Olin Corporation
Wilmington, MA Facility

OHM	Site Data/Concentration [1]						Groundwater EPC [3]	UCL [4]	EPC Exceeds UCL?
	Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean			
Benzyl Alcohol	0.01 :	0.012	1 / 39	0.002	0.002	0.005	0.002	NA	NA
Di-n-butylphthalate	0.01 :	0.012	2 / 41	0.0002	0.002	0.0048	0.002	NA	NA
Dibenzofuran	0.01 :	0.012	2 / 38	0.001	0.002	0.0048	0.002	NA	NA
Diethylphthalate	0.01 :	0.012	1 / 42	0.0003	0.0003	0.0049	0.0003	60	No
Isophorone	0.01 :	0.012	1 / 38	0.005	0.005	0.005	0.005	NA	NA
N-Nitrosodiphenylamine	0.01 :	0.012	11 / 42	0.004	0.67	0.0459	0.0459	NA	NA
Naphthalene	0.01 :	0.012	2 / 39	0.001	0.001	0.0048	0.001	20	No
Phenol	0.01 :	0.012	6 / 39	0.002	0.003	0.0046	0.003	100	No
bis(2-EthylHexyl)phthalate	0.01 :	0.014	7 / 41	0.001	0.01	0.0048	0.0048	0.7	No
Pesticides/PCBs (mg/L)									
Alpha-BHC	0.00005 :	0.00005	3 / 39	0.00005	0.000064	0.0000275	0.0000275	20	No
Beta-BHC	0.00005 :	0.00005	1 / 39	0.00006	0.00006	0.0000259	0.0000259	NA	NA
Delta-BHC	0.00005 :	0.00005	4 / 39	0.00005	0.00009	0.0000296	0.0000296	NA	NA
Gamma-BHC (Lindane)	0.00005 :	0.00005	1 / 39	0.00011	0.00011	0.0000272	0.0000272	0.008	No
Heptachlor Epoxide	0.00005 :	0.00005	3 / 39	0.00005	0.000068	0.0000278	0.0000278	0.02	No
Metals (mg/L)									
Aluminum	0.1 :	0.1	2 / 5	0.68	12	2.566	2.566	NA	NA
Barium	0 :	0	5 / 5	0.016	0.077	0.0368	0.0368	100	No
Calcium	0 :	0	5 / 5	12	440	197.4	197.4	NA	NA
Chromium	0.015 :	0.015	9 / 33	0.021	3.6	0.1608	0.1608	20	No
Cobalt	0 :	0	1 / 1	0.021	0.021	0.021	0.021	NA	NA
Copper	0 :	0	1 / 1	0.36	0.36	0.36	0.36	NA	NA
Cyanide	0 :	0	1 / 1	0.053	0.053	0.053	0.053	2	No
Iron	0.025 :	0.24	2 / 5	0.38	21	4.3185	4.3185	NA	NA
Magnesium	0 :	0	5 / 5	1.1	84	23.9	23.9	NA	NA
Manganese	0 :	0	5 / 5	0.061	10	3.0302	3.0302	NA	NA

TABLE 91
COMPARISON OF NON-ZONE II GROUNDWATER EPCs TO UCLs
GROUNDWATER EXCLUDING HOT SPOTS

Olin Corporation
Wilmington, MA Facility

OHM	Site Data/Concentration [1] Minimum SQL	Maximum SQL	Frequency of Detection	Minimum	Maximum	Arithmetic Mean	Groundwater EPC [3]	UCL [4]	EPC Exceeds UCL?
Nickel	0 :	0	1 / 1	0.11	0.11	0.11	0.11	1	No
Potassium	0 :	0	5 / 5	1.9	26	9.3	9.3	NA	NA
Sodium	0 :	0	5 / 5	19	1200	315.4	315.4	NA	NA
Zinc	0 :	0	1 / 1	0.065	0.065	0.065	0.065	20	No
Inorganics (mg/L)									
Chloride	3 :	3	86 / 87	2.8	1500	164.5874	164.5874	NA	NA
Nitrate as N	0.14 :	0.32	2 / 4	0.42	4.4	1.2625	1.2625	NA	NA
Nitrogen, Ammonia	0.04 :	0.1	87 / 92	0.23	950	91.3237	91.3237	NA	NA
Sulfate as SO4	240 :	240	88 / 89	5.8	5800	681.2292	681.2292	NA	NA

Notes:
1 Selection of OHM of Concern for this medium is presented in Table 3.
Although only VOCs were retained has OHMPC, the EPCs for all non-volatile OHM not screened out because of background or low frequency and concentration were presented in this table.
2 Samples included in Site Data set are presented in Attachment 1.
Duplicate samples were averaged with their original samples prior to calculation of summary statistics.
The arithmetic mean represents the arithmetic average of all sample results, with one-half the SQL used as the value for non-detects.
3 The EPC is the arithmetic mean concentration unless the maximum detected concentration is less than the mean concentration, in which case the maximum detected concentration is the EPC.
4 UCL = Upper Concentration Limit in Groundwater (310 CMR 40.0996(5); 4/5/96)
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material
SQL = Sample Quantitation Limit
MADEP (1995): Guidance for Disposal Site Risk Characterization - In Support of the Massachusetts Contingency Plan (WSC/ORS-95-141, July).

TABLE 92
POTENTIAL SOURCES OF HUMAN HEALTH RISK EVALUATION UNCERTAINTY

Olin Corporation
Wilmington, MA Facility

Potential Source	Direction of Effect on Risk Estimates	Justification
Risk Assessment Process		
Overall process	Overestimate	The risk assessment process generally involves a series of conservative decisions and assumptions in the face of uncertainty and variability in exposure and toxicity assessment.
Hazard Identification		
Representativeness of sampling	Overestimate	Much of the sampling and analysis has been targeted on suspected source areas or has been conducted to be representative of exposures. As a result, the overall sampling program would be considered risk-neutral to an overestimate of risk. Surface water and sediment data were generally collected to represent potential exposures. Groundwater sampling was extensive and is representative of conditions throughout the Site. Subsurface soil samples were generally targeted in source areas. Early surface soil samples were collected on a grid to evaluate potential exposure and also to evaluate the composition of suspected source areas. More than 2000 samples were collected, indicating a very thorough delineation of nature and extent of contamination.
Analytical data for Opex™ and Kempore™	Slight Underestimate	Analytical methods were not available for analysis of Opex™ and Kempore™ in soils. However, analysis of groundwater beneath Drum Areas where these chemicals were released or were expected to be present did not show that any significant leaching from soils in that area was occurring.
Selection of OHM of potential concern	Overestimate	Almost all detected analytes were retained as OHM of potential concern. Very few analytes were eliminated based on the very conservative MADEP-recommended background screening process. Analytes with very low frequencies of detection and very low concentrations were not considered in the risk assessment.
East ditch downstream sediment sampling	Possibly Overestimate	It is not certain that sediment contamination is continuous between East Ditch downstream sediment samples
Source of ammonia and sulfate in monitoring well GW-75-D	Unknown	The source of sulfate and ammonia in monitoring well GW-75-D is unknown. The Woburn landfill is adjacent to this well location and releases from the landfill are currently under investigation.

TABLE 92 (Continued) POTENTIAL SOURCES OF HUMAN HEALTH RISK EVALUATION UNCERTAINTY Olin Corporation Wilmington, MA Facility		
Potential Source	Direction of Effect on Risk Estimates	Justification
Exposure Assessment		
Likelihood of exposure pathways - current land use	Overestimate	The identified exposure pathways for on-site and off-site workers and neighborhood residents are realistic, yet conservative.The on-site worker exposure scenarios for surface water and sediment are not as likely.
Likelihood of exposure pathways - future land use	Risk neutral	With Notice of Limitations with Respect to Groundwater, Downgradient Property Status and Activity and Use Limitations, the evaluated exposure pathways are realistic.
Exposure point concentrations	Risk neutral	Overall, exposure point concentrations are arithmetic average concentrations that are considered to be realistic estimates of chronic exposures. For soils, the overall site exposure point concentration is calculated on an area-weighted basis, to give each sample or set of samples its proper site-specific weight with respect to exposure potential. For the construction worker and utility worker, the overall site exposure point concentrations are likely overestimates of exposure because they include hot spot concentrations and the Activity and Use Limitation would prevent excavation of soils in identified surface and subsurface soil hot spots without prior evaluation of risks. There is some uncertainty with respect to current surface water exposure point concentrations, in that no organic compounds were included in the analyte list for the most recent surface water sampling event. Sampling data are assumed to be representative of the site exposures. Since each monitoring and supply well within the Zone II is defined by the MCP as an exposure point for groundwater and since no one would be exposed to untreated water, these exposure points tend to overestimate exposures to groundwater in that area.
Exposure assumptions (e.g., frequency and duration)	Overestimate	Parameters selected are conservative estimates of exposure representing a reasonable exposure.
Particulate air concentrations	Risk neutral	Particulate air concentrations for the utility worker and construction worker are based on published MADEP guidance that is based on actual monitoring data.

TABLE 92 (Continued)
POTENTIAL SOURCES OF HUMAN HEALTH RISK EVALUATION UNCERTAINTY

Olin Corporation
Wilmington, MA Facility

Potential Source	Direction of Effect on Risk Estimates	Justification
Groundwater and chemical transport modeling	Overestimate	The groundwater and chemical transport modeling was conducted in a manner that reflected the available data and accepted protocols. It did not include dilution along flowpaths. The model used as source areas the monitoring wells with dense layer contamination that were closest to drinking water wells.
Impact of interim weir on surface water quality	Risk neutral	The weir has impacted surface water quality in the ditch system. The risk assessment separately evaluated analytical data collected before and after the weir was installed.
Toxicity Assessment		
Use of oral Cancer Slope Factor to evaluate carcinogenic PAH dermal exposures	Possibly Underestimate	USEPA does not recommend the use of oral Cancer Slope Factor and Relative Potencty Factors for B(a)P and other carcinogenic PAHs to evaluate dermal exposures. Oral values may underestimate dermal risk.
Lack of inhalation toxicity values	Underestimate	Inhalation reference doses (RfDs) are not available for all OHMPCs being evaluated for inhalation exposures (fugitive dust). Therefore, risks cannot be quantified and are underestimated.
Use of linearized, multi-stage model to derive cancer slope factors	Overestimate	The model assumes a non-threshold, linear response, at low doses of carcinogens. Many compounds induce cancer by non-genotoxic mechanisms. This model results in 95 percent upper confidence limits of cancer potency. Potency is unlikely to be higher and may be as low as zero.
Risk Characterization		
Summation of risks among all exposure points and media	Probably Overestimate	The theoretical exposure profiles that include each receptor's exposure to multiple media for long time periods probably overestimate actual exposure conditions.
Comparison of groundwater concentrations within the Zone II to drinking water standards	Overestimate	Comparison of monitoring well data from the Zone II area to drinking water standards probably overestimates risk. Transport modeling indicates that minimal impact on Town wells would be expected via transport from this area. Given that the area is a wetland, it is unlikely that any private wells would be installed there.
Summation of HQ's	Overestimate	Dose-response values are based on different critical effects or different target organs.

ATTACHMENT 1

ATTACHMENT 1

ANALYTICAL DATA USED IN THE HUMAN HEALTH RISK CHARACTERIZATION

This attachment identifies the analytical data used in the human health risk characterization. This attachment identifies the samples that were used to produce the analytical data summaries for each data set evaluated in the risk characterization; it does not provide the raw analytical data for the identified samples.

Tables A1-1 through A1-5 provide lists of samples for surface soil, subsurface soil, groundwater, surface water, and sediment, respectively. The list for each medium is segregated into separate exposure points, which are identified with a human health exposure point number (HHEPC #). For each HHEPC #, the analytical data for each sample included in that exposure point were used to produce statistical data summaries for the exposure point. The following table identifies the exposure point that corresponds to each HHEPC # identified on Tables A1-1 through A1-5. The data summaries developed for HHEPC #s listed in non-italicized print were used to quantitatively evaluate actual exposure points in the risk characterization; the data summaries developed for HHEPC #s listed in italicized print were used for other purposes, such as selection of oil and/or hazardous material of potential concern.

TABLE A1-1
SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION
SURFACE SOIL

Olin Corporation
Wilmington, MA Facility

LOCATION	SAMPLENUM	MATRIXTYPE	DATE TAKEN	ISA BLANK	QAQC TYPE	COMMENT	STUDY AREA	HHEPC	HHEPC#
G1-DRMB	1461445	SS	15-Dec-96	FALSE			DRB	Area 8 -hot	1
G2-DRMB	1461446	SS	15-Dec-96	FALSE			DRB	Area 8 -hot	1
G3-DRMB	1461447	SS	15-Dec-96	FALSE			DRB	Area 8 -hot	1
G4-DRMB	1461448	SS	15-Dec-96	FALSE			DRB	Area 8 -hot	1
DRMB-(COMP)	1461449	SS	15-Dec-96	FALSE			DRB	Area 8 -hot	1
AREA 08	1000465	SS	09-Jul-91	FALSE			A08	Area 8 Hot	1
CPDA-1	1461460	SS	16-Dec-96	FALSE			A08	Area 8 Hot	1
CPDA-2	1461461	SS	16-Dec-96	FALSE			A08	Area 8 Hot	1
CPDA-3	1461462	SS	16-Dec-96	FALSE			A08	Area 8 Hot	1
CPDA-4	1461463	SS	16-Dec-96	FALSE			A08	Area 8 Hot	1
CPDA-5	1461464	SS	16-Dec-96	FALSE			A08	Area 8 Hot	1
CPDA-6	1461465	SS	16-Dec-96	FALSE			A08	Area 8 Hot	1
CPDA-7	1461466	SS	16-Dec-96	FALSE			A08	Area 8 Hot	1
CPDA-8	1461467	SS	16-Dec-96	FALSE			A08	Area 8 Hot	1
CPDA-9	1461468	SS	16-Dec-96	FALSE			A08	Area 8 Hot	1
AREA8-1	1461469	SS	16-Dec-96	FALSE			A08	Area 8 Hot	1
AREA8-2	1461470	SS	16-Dec-96	FALSE			A08	Area 8 Hot	1
AREA8-3	1461471	SS	16-Dec-96	FALSE			A08	Area 8 Hot	1
AREA8-4	1461472	SS	16-Dec-96	FALSE			A08	Area 8 Hot	1
A8CW-1	1461473	SS	16-Dec-96	FALSE			A08	Area 8 Hot	1
A8CW-2	1461474	SS	16-Dec-96	FALSE			A08	Area 8 Hot	1
A8CW-3	1461475	SS	16-Dec-96	FALSE			A08	Area 8 Hot	1
A8CW-4	1461476	SS	16-Dec-96	FALSE			A08	Area 8 Hot	1
CPDA-9	1461495	SS	16-Dec-96	FALSE	FIELD DUPLICATE	DUP OF 1461468	A08	Area 8 Hot	1
BS017PND	1461529	SS	21-Jan-97	FALSE			A08	Area 8 Hot	1
BS018PND	1461530	SS	21-Jan-97	FALSE			A08	Area 8 Hot	1
GA1-DRMA	1461450	SS	15-Dec-96	FALSE			DRA	Drum Area A - hot	2
GA2-DRMA	1461451	SS	15-Dec-96	FALSE			DRA	Drum Area A - hot	2
GA3-DRMA	1461452	SS	15-Dec-96	FALSE			DRA	Drum Area A - hot	2
GA4-DRMA	1461453	SS	15-Dec-96	FALSE			DRA	Drum Area A - hot	2
DRMA(COMP A)	1461454	SS	15-Dec-96	FALSE			DRA	Drum Area A - hot	2
GB1-DRMA	1461455	SS	15-Dec-96	FALSE			DRA	Drum Area A - hot	2
GB2-DRMA	1461456	SS	15-Dec-96	FALSE			DRA	Drum Area A - hot	2
GB3-DRMA	1461457	SS	15-Dec-96	FALSE			DRA	Drum Area A - hot	2
GB4-DRMA	1461458	SS	15-Dec-96	FALSE			DRA	Drum Area A - hot	2
DRMA(COMP B)	1461459	SS	15-Dec-96	FALSE			DRA	Drum Area A - hot	2
LAKE POLY-1	1461442	SS	15-Dec-96	FALSE			LP	Lake poly - hot	3
LAKE POLY-2	1461443	SS	15-Dec-96	FALSE			LP	Lake poly - hot	3
LAKE POLY-3	1461444	SS	15-Dec-96	FALSE			LP	Lake poly - hot	3
LAKE POLY-2	1461494	SS	15-Dec-96	FALSE	FIELD DUPLICATE	DUP OF 1461443	LP	Lake poly - hot	3

TABLE A1-1									
SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION									
SURFACE SOIL									
Olin Corporation									
Wilmington, MA Facility									
LOCATION	SAMPLENUM	MATRIXTYPE	DATE TAKEN	QA BLANK	QAQC TYPE	COMMENT	STUDY AREA	[illegible]	[illegible]
SWMU26-1	1461489	SS	15-Dec-96	FALSE			S-26	No buildings	4
SWMU26-2	1461490	SS	15-Dec-96	FALSE			S-26	No buildings	4
SWMU26-3	1461491	SS	15-Dec-96	FALSE			S-26	No buildings	4
SWMU26-4	1461492	SS	15-Dec-96	FALSE			S-26	No buildings	4
SWMU26 COMP	1461493	SS	15-Dec-96	FALSE			S-26	No buildings	4
AREA 01	1000458	SS	08-Jul-91	FALSE			A01	No buildings	4
AREA 09	1000466	SS	09-Jul-91	FALSE			A09	No buildings	4
A9CW-1	1461477	SS	16-Dec-96	FALSE			A09	No buildings	4
A9CW-2	1461478	SS	16-Dec-96	FALSE			A09	No buildings	4
A9CW-3	1461479	SS	16-Dec-96	FALSE			A09	No buildings	4
A9CW-4	1461480	SS	16-Dec-96	FALSE			A09	No buildings	4
A9CW-(COMP)	1461481	SS	16-Dec-96	FALSE			A09	No buildings	4
AREA 1-1	1461482	SS	15-Dec-96	FALSE			A01	No buildings	4
AREA 1-2	1461483	SS	15-Dec-96	FALSE			A01	No buildings	4
AREA 1-3	1461484	SS	15-Dec-96	FALSE			A01	No buildings	4
AREA 1-4	1461485	SS	15-Dec-96	FALSE			A01	No buildings	4
AREA 1-5	1461486	SS	15-Dec-96	FALSE			A01	No buildings	4
AREA 1-6	1461487	SS	15-Dec-96	FALSE			A01	No buildings	4
AREA 1(COMP)	1461488	SS	15-Dec-96	FALSE			A01	No buildings	4
BS019WMD	1461531	SS	21-Jan-97	FALSE			A09	No buildings	4
BS020WMD	1461532	SS	21-Jan-97	FALSE			A09	No buildings	4
AREA 10	1000467	SS	09-Jul-91	FALSE			A10	Sulfate landfill	5
AREA 10	1000502	SS	09-Jul-91	FALSE	FIELD DUPLICATE	DUP OF 1000467	A10	Sulfate landfill	5
SWMU-27	1000468	SS	30-Jul-91	FALSE			S-27	SWMU-27 hot	6
BS013WDX	1461521	SS	21-Jan-97	FALSE			S-27	SWMU-27 hot	6
BS014WDX	1461526	SS	21-Jan-97	FALSE			S-27	SWMU-27 hot	6
SWMU-30	1000469	SS	30-Jul-91	FALSE			S-30	SWMU-30 hot	7
BS015SDX	1461527	SS	21-Jan-97	FALSE			S-30	SWMU-30 hot	7
SWMU-33	1000470	SS	30-Jul-91	FALSE			S-33	SWMU-33 hot	8
BS016SMD	1461528	SS	21-Jan-97	FALSE			S-33	SWMU-33 hot	8
AREA 02	1000459	SS	09-Jul-91	FALSE			A02	With buildings	9
AREA 03	1000460	SS	09-Jul-91	FALSE			A03	With buildings	9
AREA 04	1000461	SS	09-Jul-91	FALSE			A04	With buildings	9
AREA 05	1000462	SS	09-Jul-91	FALSE			A05	With buildings	9
AREA 06	1000463	SS	09-Jul-91	FALSE			A06	With buildings	9
AREA 07	1000464	SS	09-Jul-91	FALSE			A07	With buildings	9
SWMU-25	1000471	SS	07-May-93	FALSE			A06	With buildings	9

TABLE A1-1									
SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION									
SURFACE SOIL									
Olin Corporation									
Wilmington, MA Facility									
LOCATION	SAMPLENUM	MATRIXTYPE	DATE TAKEN	QA BLANK	QAQC TYPE	COMMENT	STUDY AREA	HHEPC	HHEPC#
G1-DRMB	1461445	SS	15-Dec-96	FALSE			DRB	Area 8 -hot	10
G2-DRMB	1461446	SS	15-Dec-96	FALSE			DRB	Area 8 -hot	10
G3-DRMB	1461447	SS	15-Dec-96	FALSE			DRB	Area 8 -hot	10
G4-DRMB	1461448	SS	15-Dec-96	FALSE			DRB	Area 8 -hot	10
DRMB-(COMP)	1461449	SS	15-Dec-96	FALSE			DRB	Area 8 -hot	10
AREA 08	1000465	SS	09-Jul-91	FALSE			A08	Area 8 Hot	10
CPDA-1	1461460	SS	16-Dec-96	FALSE			A08	Area 8 Hot	10
CPDA-2	1461461	SS	16-Dec-96	FALSE			A08	Area 8 Hot	10
CPDA-3	1461462	SS	16-Dec-96	FALSE			A08	Area 8 Hot	10
CPDA-4	1461463	SS	16-Dec-96	FALSE			A08	Area 8 Hot	10
CPDA-5	1461464	SS	16-Dec-96	FALSE			A08	Area 8 Hot	10
CPDA-6	1461465	SS	16-Dec-96	FALSE			A08	Area 8 Hot	10
CPDA-7	1461466	SS	16-Dec-96	FALSE			A08	Area 8 Hot	10
CPDA-8	1461467	SS	16-Dec-96	FALSE			A08	Area 8 Hot	10
CPDA-9	1461468	SS	16-Dec-96	FALSE			A08	Area 8 Hot	10
AREA8-1	1461469	SS	16-Dec-96	FALSE			A08	Area 8 Hot	10
AREA8-2	1461470	SS	16-Dec-96	FALSE			A08	Area 8 Hot	10
AREA8-3	1461471	SS	16-Dec-96	FALSE			A08	Area 8 Hot	10
AREA8-4	1461472	SS	16-Dec-96	FALSE			A08	Area 8 Hot	10
A8CW-1	1461473	SS	16-Dec-96	FALSE			A08	Area 8 Hot	10
A8CW-2	1461474	SS	16-Dec-96	FALSE			A08	Area 8 Hot	10
A8CW-3	1461475	SS	16-Dec-96	FALSE			A08	Area 8 Hot	10
A8CW-4	1461476	SS	16-Dec-96	FALSE			A08	Area 8 Hot	10
CPDA-9	1461495	SS	16-Dec-96	FALSE	FIELD DUPLICATE	DUP OF 1461468	A08	Area 8 Hot	10
BS017PND	1461529	SS	21-Jan-97	FALSE			A08	Area 8 Hot	10
BS018PND	1461530	SS	21-Jan-97	FALSE			A08	Area 8 Hot	10
GA1-DRMA	1461450	SS	15-Dec-96	FALSE			DRA	Drum Area A - hot	10
GA2-DRMA	1461451	SS	15-Dec-96	FALSE			DRA	Drum Area A - hot	10
GA3-DRMA	1461452	SS	15-Dec-96	FALSE			DRA	Drum Area A - hot	10
GA4-DRMA	1461453	SS	15-Dec-96	FALSE			DRA	Drum Area A - hot	10
DRMA(COMP A)	1461454	SS	15-Dec-96	FALSE			DRA	Drum Area A - hot	10
GB1-DRMA	1461455	SS	15-Dec-96	FALSE			DRA	Drum Area A - hot	10
GB2-DRMA	1461456	SS	15-Dec-96	FALSE			DRA	Drum Area A - hot	10
GB3-DRMA	1461457	SS	15-Dec-96	FALSE			DRA	Drum Area A - hot	10
GB4-DRMA	1461458	SS	15-Dec-96	FALSE			DRA	Drum Area A - hot	10
DRMA(COMP B)	1461459	SS	15-Dec-96	FALSE			DRA	Drum Area A - hot	10
LAKE POLY-1	1461442	SS	15-Dec-96	FALSE			LP	Lake poly - hot	10
LAKE POLY-2	1461443	SS	15-Dec-96	FALSE			LP	Lake poly - hot	10
LAKE POLY-3	1461444	SS	15-Dec-96	FALSE			LP	Lake poly - hot	10
LAKE POLY-2	1461494	SS	15-Dec-96	FALSE	FIELD DUPLICATE	DUP OF 1461443	LP	Lake poly - hot	10
SWMU26-1	1461489	SS	15-Dec-96	FALSE			S-26	No buildings	10

TABLE A1-1									
SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION									
SURFACE SOIL									
Olin Corporation									
Wilmington, MA Facility									
LOCATION	SAMPLENUM	MATRIXTYPE	DATE TAKEN	IGA BLANK	QAQC TYPE	COMMENT	STUDY AREA	HHEPC	HHEPC#
SWMU26-2	1461490	SS	15-Dec-96	FALSE			S-26	No buildings	10
SWMU26-3	1461491	SS	15-Dec-96	FALSE			S-26	No buildings	10
SWMU26-4	1461492	SS	15-Dec-96	FALSE			S-26	No buildings	10
SWMU26 COMP	1461493	SS	15-Dec-96	FALSE			S-26	No buildings	10
AREA 01	1000458	SS	08-Jul-91	FALSE			A01	No buildings	10
AREA 09	1000466	SS	09-Jul-91	FALSE			A09	No buildings	10
A9CW-1	1461477	SS	16-Dec-96	FALSE			A09	No buildings	10
A9CW-2	1461478	SS	16-Dec-96	FALSE			A09	No buildings	10
A9CW-3	1461479	SS	16-Dec-96	FALSE			A09	No buildings	10
A9CW-4	1461480	SS	16-Dec-96	FALSE			A09	No buildings	10
A9CW-(COMP)	1461481	SS	16-Dec-96	FALSE			A09	No buildings	10
AREA 1-1	1461482	SS	15-Dec-96	FALSE			A01	No buildings	10
AREA 1-2	1461483	SS	15-Dec-96	FALSE			A01	No buildings	10
AREA 1-3	1461484	SS	15-Dec-96	FALSE			A01	No buildings	10
AREA 1-4	1461485	SS	15-Dec-96	FALSE			A01	No buildings	10
AREA 1-5	1461486	SS	15-Dec-96	FALSE			A01	No buildings	10
AREA 1-6	1461487	SS	15-Dec-96	FALSE			A01	No buildings	10
AREA 1(COMP)	1461488	SS	15-Dec-96	FALSE			A01	No buildings	10
BS019WMD	1461531	SS	21-Jan-97	FALSE			A09	No buildings	10
BS020WMD	1461532	SS	21-Jan-97	FALSE			A09	No buildings	10
AREA 10	1000467	SS	09-Jul-91	FALSE			A10	Sulfate landfill	10
AREA 10	1000502	SS	09-Jul-91	FALSE	FIELD DUPLICATE	DUP OF 1000467	A10	Sulfate landfill	10
SWMU-27	1000468	SS	30-Jul-91	FALSE			S-27	SWMU-27 hot	10
BS013WDX	1461521	SS	21-Jan-97	FALSE			S-27	SWMU-27 hot	10
BS014WDX	1461526	SS	21-Jan-97	FALSE			S-27	SWMU-27 hot	10
SWMU-30	1000469	SS	30-Jul-91	FALSE			S-30	SWMU-30 hot	10
BS015SDX	1461527	SS	21-Jan-97	FALSE			S-30	SWMU-30 hot	10
SWMU-33	1000470	SS	30-Jul-91	FALSE			S-33	SWMU-33 hot	10
BS016SMD	1461528	SS	21-Jan-97	FALSE			S-33	SWMU-33 hot	10
AREA 02	1000459	SS	09-Jul-91	FALSE			A02	With buildings	10
AREA 03	1000460	SS	09-Jul-91	FALSE			A03	With buildings	10
AREA 04	1000461	SS	09-Jul-91	FALSE			A04	With buildings	10
AREA 05	1000462	SS	09-Jul-91	FALSE			A05	With buildings	10
AREA 06	1000463	SS	09-Jul-91	FALSE			A06	With buildings	10
AREA 07	1000464	SS	09-Jul-91	FALSE			A07	With buildings	10
SWMU-25	1000471	SS	07-May-93	FALSE			A06	With buildings	10

TABLE A1-2								
SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION								
SUBSURFACE SOIL								
Olin Corporation								
Wilmington, MA Facility								
LOCATION	SAMPLENUM	MATRIXTYPE	DATE TAKEN	ISA BLANK	QAQC TYPE	COMMENT	STUDY AREA	HHEPC#
BH12	1000530	S	10-Jun-91	FALSE		4-6FT	LP	11
BH14	1000532	S	10-Jun-91	FALSE		4-6FT	LP	11
BH16	1000534	S	10-Jun-91	FALSE		4-6FT	LP	11
BH17	1000535	S	10-Jun-91	FALSE		8-10FT	LP	11
BH36	1000554	S	06-Feb-92	FALSE		4-6FT	LP	11
BH37	1000555	S	06-Feb-92	FALSE		4-6FT	LP	11
BH38	1000556	S	06-Feb-92	FALSE		3-5FT	LP	11
LPB-1(4-6)	1460211	S	18-Jan-95	FALSE			LP	11
LPB-1(6-8)	1460212	S	18-Jan-95	FALSE			LP	11
LPB-2(7-8)	1460213	S	18-Jan-95	FALSE			LP	11
LPB-2(8-9)	1460214	S	18-Jan-95	FALSE			LP	11
TP-21-SN7	1000488	W	8-Oct-91	FALSE			DRMB	12
OW-249-D	1460164	W	11-Nov-92	FALSE			DRMB	12
TP-21-SN8	1000491	S	08-Oct-91	FALSE		SAMPLE #8	DRMB	12
TP-6-SN2	1000484	W	2-Oct-91	FALSE			DRMA	13
TP-8-SN3	1000485	W	3-Oct-91	FALSE			DRMA	13
TP-8-SN4	1000486	W	3-Oct-91	FALSE			DRMA	13
TP-8-SN5	1000487	W	3-Oct-91	FALSE			DRMA	13
OW-249-A	1460161	W	11-Nov-92	FALSE			DRMA	13
OW-249-B	1460162	W	11-Nov-92	FALSE			DRMA	13
OW-249-C	1460163	W	11-Nov-92	FALSE			DRMA	13
BH01	1000518	S	05-Jun-91	FALSE		6-8FT	LAGOONS	14
BH02	1000519	S	05-Jun-91	FALSE		6-8FT	LAGOONS	14
BH03	1000520	S	05-Jun-91	FALSE		6-8FT	LAGOONS	14
BH04	1000521	S	05-Jun-91	FALSE		6-8FT	LAGOONS	14
BH05	1000522	S	06-Jun-91	FALSE		6-8FT	LAGOONS	14
BH06	1000523	S	06-Jun-91	FALSE		4-6FT	LAGOONS	14
BH07	1000524	S	06-Jun-91	FALSE		4-6FT	LAGOONS	14
BH08	1000525	S	07-Jun-91	FALSE		4-6FT	LAGOONS	14
BH09	1000526	S	07-Jun-91	FALSE		4-6FT	LAGOONS	14
BH10	1000527	S	07-Jun-91	FALSE		4-6FT	LAGOONS	14

TABLE A1-2								
SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION								
SUBSURFACE SOIL								
Olin Corporation								
Wilmington, MA Facility								
LOCATION	SAMPLENUM	MATRIXTYPE	DATE TAKEN	ISA BLANK	QAQC TYPE	COMMENT	STUDY AREA	HHEPC#
BH26	1000542	S	11-Jun-91	FALSE		7-9FT	PLANTB	15
BH28	1000544	S	11-Jun-91	FALSE		4-6FT	PLANTB	15
BH28	1000545	S	11-Jun-91	FALSE		4-6FT	PLANTB	15
BH30	1000547	S	11-Jun-91	FALSE		8-10FT	PLANTB	15
BH34	1000552	S	11-Jun-91	FALSE		6-8FT	PLANTB	15
TP-1-SN1	1000489	S	02-Oct-91	FALSE		SAMPLE #1	SL	16
TP-19-SN6	1000490	S	07-Oct-91	FALSE		SAMPLE #6	NOT HOT	17
BH25	1000505	S	10-Jun-91	FALSE		4-6FT	NOT HOT	17
BH11	1000528	S	07-Jun-91	FALSE		4-6FT	NOT HOT	17
BH11	1000529	S	07-Jun-91	FALSE		10-12FT	NOT HOT	17
BH13	1000531	S	10-Jun-91	FALSE		8-10FT	NOT HOT	17
BH15	1000533	S	10-Jun-91	FALSE		8-10FT	NOT HOT	17
BH18	1000536	S	10-Jun-91	FALSE		4-6FT	NOT HOT	17
BH19	1000537	S	11-Jun-91	FALSE		5-7FT	NOT HOT	17
BH20	1000538	S	10-Jun-91	FALSE		10-12FT	NOT HOT	17
BH21	1000539	S	10-Jun-91	FALSE		8-10FT	NOT HOT	17
BH22	1000540	S	10-Jun-91	FALSE		8-10FT	NOT HOT	17
BH23	1000541	S	10-Jun-91	FALSE		4-6FT	NOT HOT	17
BH27	1000543	S	11-Jun-91	FALSE		4-6FT	NOT HOT	17
BH29	1000546	S	11-Jun-91	FALSE		4-6FT	NOT HOT	17
BH31	1000548	S	11-Jun-91	FALSE		3-5FT	NOT HOT	17
BH32	1000549	S	11-Jun-91	FALSE		4-6FT	NOT HOT	17
BH32	1000550	S	11-Jun-91	FALSE		4-6FT	NOT HOT	17
BH33	1000551	S	11-Jun-91	FALSE		6-8FT	NOT HOT	17
BH35	1000553	S	11-Jun-91	FALSE		6-8FT	NOT HOT	17
BH39	1000557	S	06-Feb-92	FALSE		4-6FT	NOT HOT	17
BH40	1000558	S	06-Feb-92	FALSE		4-6FT	NOT HOT	17
BH24	1000561	S	10-Jun-91	FALSE		4-6FT	NOT HOT	17
BH12	1000530	S	10-Jun-91	FALSE		4-6FT	LP	18
BH14	1000532	S	10-Jun-91	FALSE		4-6FT	LP	18

TABLE A1-2								
SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION								
SUBSURFACE SOIL								
Olin Corporation								
Wilmington, MA Facility								
LOCATION	SAMPLENUM	MATRIXTYPE	DATE TAKEN	ISA BLANK	QAQC TYPE	COMMENT	STUDY AREA	HHEPC#
BH16	1000534	S	10-Jun-91	FALSE		4-6FT	LP	18
BH17	1000535	S	10-Jun-91	FALSE		8-10FT	LP	18
BH36	1000554	S	06-Feb-92	FALSE		4-6FT	LP	18
BH37	1000555	S	06-Feb-92	FALSE		4-6FT	LP	18
BH38	1000556	S	06-Feb-92	FALSE		3-5FT	LP	18
LPB-1(4-6)	1460211	S	18-Jan-95	FALSE			LP	18
LPB-1(6-8)	1460212	S	18-Jan-95	FALSE			LP	18
LPB-2(7-8)	1460213	S	18-Jan-95	FALSE			LP	18
LPB-2(8-9)	1460214	S	18-Jan-95	FALSE			LP	18
OW-249-A	1460164	W	11-Nov-92	FALSE			DRMB	18
TP-21-SN8	1000491	S	08-Oct-91	FALSE		SAMPLE #8	DRMB	18
TP-6-SN2	1000484	W	2-Oct-91	FALSE			DRMA	18
TP-8-SN3	1000485	W	3-Oct-91	FALSE			DRMA	18
TP-8-SN4	1000486	W	3-Oct-91	FALSE			DRMA	18
TP-8-SN5	1000487	W	3-Oct-91	FALSE			DRMA	18
OW-249-D	1460161	W	11-Nov-92	FALSE			DRMA	18
OW-249-B	1460162	W	11-Nov-92	FALSE			DRMA	18
OW-249-C	1460163	W	11-Nov-92	FALSE			DRMA	18
BH01	1000518	S	05-Jun-91	FALSE		6-8FT	LAGOONS	18
BH02	1000519	S	05-Jun-91	FALSE		6-8FT	LAGOONS	18
BH03	1000520	S	05-Jun-91	FALSE		6-8FT	LAGOONS	18
BH04	1000521	S	05-Jun-91	FALSE		6-8FT	LAGOONS	18
BH05	1000522	S	06-Jun-91	FALSE		6-8FT	LAGOONS	18
BH06	1000523	S	06-Jun-91	FALSE		4-6FT	LAGOONS	18
BH07	1000524	S	06-Jun-91	FALSE		4-6FT	LAGOONS	18
BH08	1000525	S	07-Jun-91	FALSE		4-6FT	LAGOONS	18
BH09	1000526	S	07-Jun-91	FALSE		4-6FT	LAGOONS	18
BH10	1000527	S	07-Jun-91	FALSE		4-6FT	LAGOONS	18
BH26	1000542	S	11-Jun-91	FALSE		7-9FT	PLANTB	18
BH28	1000544	S	11-Jun-91	FALSE		4-6FT	PLANTB	18
BH28	1000545	S	11-Jun-91	FALSE		4-6FT	PLANTB	18
BH30	1000547	S	11-Jun-91	FALSE		8-10FT	PLANTB	18
BH34	1000552	S	11-Jun-91	FALSE		6-8FT	PLANTB	18
TP-1-SN1	1000489	S	02-Oct-91	FALSE		SAMPLE #1	SL	18

TABLE A1-2								
SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION								
SUBSURFACE SOIL								
Olin Corporation								
Wilmington, MA Facility								
LOCATION	SAMPLENUM	MATRIXTYPE	DATE TAKEN	IS A BLANK	QAQC TYPE	COMMENT	STUDY AREA	HHEPC#
TP-19-SN6	1000490	S	07-Oct-91	FALSE		SAMPLE #6	NOT HOT	18
BH25	1000505	S	10-Jun-91	FALSE		4-6FT	NOT HOT	18
BH11	1000528	S	07-Jun-91	FALSE		4-6FT	NOT HOT	18
BH11	1000529	S	07-Jun-91	FALSE		10-12FT	NOT HOT	18
BH13	1000531	S	10-Jun-91	FALSE		8-10FT	NOT HOT	18
BH15	1000533	S	10-Jun-91	FALSE		8-10FT	NOT HOT	18
BH18	1000536	S	10-Jun-91	FALSE		4-6FT	NOT HOT	18
BH19	1000537	S	11-Jun-91	FALSE		5-7FT	NOT HOT	18
BH20	1000538	S	10-Jun-91	FALSE		10-12FT	NOT HOT	18
BH21	1000539	S	10-Jun-91	FALSE		8-10FT	NOT HOT	18
BH22	1000540	S	10-Jun-91	FALSE		8-10FT	NOT HOT	18
BH23	1000541	S	10-Jun-91	FALSE		4-6FT	NOT HOT	18
BH27	1000543	S	11-Jun-91	FALSE		4-6FT	NOT HOT	18
BH29	1000546	S	11-Jun-91	FALSE		4-6FT	NOT HOT	18
BH31	1000548	S	11-Jun-91	FALSE		3-5FT	NOT HOT	18
BH32	1000549	S	11-Jun-91	FALSE		4-6FT	NOT HOT	18
BH32	1000550	S	11-Jun-91	FALSE		4-6FT	NOT HOT	18
BH33	1000551	S	11-Jun-91	FALSE		6-8FT	NOT HOT	18
BH35	1000553	S	11-Jun-91	FALSE		6-8FT	NOT HOT	18
BH39	1000557	S	06-Feb-92	FALSE		4-6FT	NOT HOT	18
BH40	1000558	S	06-Feb-92	FALSE		4-6FT	NOT HOT	18
BH24	1000561	S	10-Jun-91	FALSE		4-6FT	NOT HOT	18

TABLE A1-3			
SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION			
GROUNDWATER			
Olin Corporation			
Wilmington, MA Facility			
HHEPC#	LOCATION	SAMPLENUM	DATE TAKEN
All Non-Zone 2 Samples			
100	GT-04-D	1000914	01-May-90
100	GT-04-S	1000915	01-May-90
100	GT-05	1000916	01-May-90
100	GT-06-D	1000917	01-May-90
100	GT-06-S	1000918	01-May-90
100	GT-07	1000919	01-May-90
100	GT-09-D	1000920	01-May-90
100	GT-09-S	1000921	01-May-90
100	GW-03-D	1000001	01-Aug-91
100	GW-03-D	1000218	05-Nov-92
100	GW-03-S	1000002	01-Aug-91
100	GW-03-S	1000219	05-Nov-92
100	GW-04	1000003	01-Aug-91
100	GW-04	1000220	05-Nov-92
100	GW-04-D	1000004	01-Aug-91
100	GW-04-D	1000221	05-Nov-92
100	GW-05	1000875	01-May-90
100	GW-06-D	1000202	03-Nov-92
100	GW-06-S	1000203	03-Nov-92
100	GW-07	1461377	18-Dec-96
100	GW-08	1460457	19-Jul-95
100	GW-08	1460469	19-Jul-95
100	GW-10-D	1000005	01-Aug-91
100	GW-10-D	1000234	09-Nov-92
100	GW-10-S	1000006	01-Aug-91
100	GW-10-S	1000261	12-Nov-92
100	GW-10-S	1461261	17-Oct-96
100	GW-10-S	1461568	24-Jan-97
100	GW-11	1000007	01-Aug-91
100	GW-11	1000235	09-Nov-92
100	GW-11	1461569	24-Jan-97
100	GW-17-D	1000009	01-Aug-91
100	GW-17-D	1000204	03-Nov-92
100	GW-17-D	1461014	01-May-96
100	GW-17-S	1000010	01-Aug-91
100	GW-17-S	1000205	03-Nov-92
100	GW-17-S	1461013	01-May-96
100	GW-18-D	1000011	01-Aug-91
100	GW-18-D	1000236	09-Nov-92
100	GW-19-D	1000237	09-Nov-92
100	GW-19-S	1000938	01-May-90
100	GW-19-S	1461570	24-Jan-97
100	GW-20	1000939	01-May-90
100	GW-21-D	1000012	01-Aug-91
100	GW-21-D	1000228	06-Nov-92
100	GW-21-S	1000013	01-Aug-91
100	GW-21-S	1000229	06-Nov-92
100	GW-22-D	1000942	16-Feb-90

TABLE A1-3			
SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION			
GROUNDWATER			
Olin Corporation			
Wilmington, MA Facility			
HHRPC#	LOCATION	SAMPLENUM	DATE TAKEN
100	GW-22-D	1000222	05-Nov-92
100	GW-22-D	1461022	02-May-96
100	GW-22-S	1000223	05-Nov-92
100	GW-22-S	1000944	16-Feb-90
100	GW-22-S	1461020	02-May-96
100	GW-24	1000014	01-Aug-91
100	GW-24	1461571	24-Jan-97
100	GW-25	1000015	01-Aug-91
100	GW-25	1000275	16-Nov-92
100	GW-25	1461262	17-Oct-96
100	GW-25	1461572	13-Oct-95
100	GW-26	1000016	01-Aug-91
100	GW-26	1000270	13-Nov-92
100	GW-26	1461573	24-Jan-97
100	GW-27-D	1000238	09-Nov-92
100	GW-27-D	1460255	13-Jan-95
100	GW-27-D	1461016	01-May-96
100	GW-27-S	1000239	09-Nov-92
100	GW-27-S	1461015	01-May-96
100	GW-28-D	1000017	01-Aug-91
100	GW-28-D	1000230	06-Nov-92
100	GW-28-S	1000018	01-Aug-91
100	GW-28-S	1000231	06-Nov-92
100	GW-28-S	1461263	17-Oct-96
100	GW-28-S	1461304	17-Oct-96
100	GW-29-D	1000019	01-Aug-91
100	GW-29-D	1000232	06-Nov-92
100	GW-29-S	1000020	01-Aug-91
100	GW-29-S	1000233	06-Nov-92
100	GW-30-DR	1000958	16-Feb-90
100	GW-30-DR	1000240	09-Nov-92
100	GW-33-D	1000206	03-Nov-92
100	GW-33-D	1000964	16-Feb-90
100	GW-33-S	1000207	03-Nov-92
100	GW-33-S	1000966	16-Feb-90
100	GW-34-D	1000224	05-Nov-92
100	GW-34-D	1000968	16-Feb-90
100	GW-34-D	1461019	02-May-96
100	GW-34-S	1000225	05-Nov-92
100	GW-34-S	1000847	16-Feb-90
100	GW-34-S	1461018	02-May-96
100	GW-35-D	1000849	16-Feb-90
100	GW-35-D	1000226	05-Nov-92
100	GW-35-D	1000245	10-Nov-92
100	GW-35-D	1461023	02-May-96
100	GW-35-S	1000227	05-Nov-92
100	GW-35-S	1000851	16-Feb-90
100	GW-35-S	1461017	01-May-96
100	GW-35-S	1461574	24-Jan-97
100	GW-36	1000052	10-Dec-91

TABLE A1-3			
SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION			
GROUNDWATER			
Olin Corporation			
Wilmington, MA Facility			
HHEPC#	LOCATION	SAMPLENUM	DATE TAKEN
100	GW-36	1000276	16-Nov-92
100	GW-36	1461024	02-May-96
100	GW-36	1461314	13-Jan-95
100	GW-37	1000022	01-Aug-91
100	GW-37	1000277	16-Nov-92
100	GW-37	1461025	02-May-96
100	GW-38	1000023	01-Aug-91
100	GW-38	1000241	09-Nov-92
100	GW-39	1000024	01-Aug-91
100	GW-39	1000253	11-Nov-92
100	GW-39	1461575	13-Oct-95
100	GW-40-D	1000254	11-Nov-92
100	GW-40-D	1460621	17-Oct-95
100	GW-40-D	1460637	17-Oct-95
100	GW-40-S	1000255	11-Nov-92
100	GW-40-S	1460620	17-Oct-95
100	GW-40-S	1460636	17-Oct-95
100	GW-42-D	1000256	11-Nov-92
100	GW-42-D	1460193	11-Jan-95
100	GW-42-D	1460611	17-Oct-95
100	GW-42-S	1000257	11-Nov-92
100	GW-42-S	1460664	18-Oct-95
100	GW-42-S	1461265	16-Oct-96
100	GW-42-S	1461576	24-Jan-97
100	GW-43-D	1000258	11-Nov-92
100	GW-43-D	1460616	17-Oct-95
100	GW-43-S	1000259	11-Nov-92
100	GW-43-S	1460613	17-Oct-95
100	GW-43-S	1461264	16-Oct-96
100	GW-43-S	1461577	24-Jan-97
100	GW-45-D	1000262	12-Nov-92
100	GW-45-D	1460609	17-Oct-95
100	GW-45-S	1000263	12-Nov-92
100	GW-45-S	1460608	17-Oct-95
100	GW-45-S	1461271	17-Oct-96
100	GW-45-S	1461308	17-Oct-96
100	GW-50-D	1000216	04-Nov-92
100	GW-50-D	1460194	12-Jan-95
100	GW-50-D	1460619	17-Oct-95
100	GW-50-S	1000217	04-Nov-92
100	GW-50-S	1460654	18-Oct-95
100	GW-50-S	1460671	18-Oct-95
100	GW-51-D	1000036	01-Aug-91
100	GW-51-D	1000208	03-Nov-92
100	GW-51-S	1000037	01-Aug-91
100	GW-51-S	1000209	03-Nov-92
100	GW-54-D	1000042	01-Aug-91
100	GW-54-D	1000214	03-Nov-92
100	GW-54-D	1000372	01-Aug-91
100	GW-54-S	1000043	01-Aug-91

TABLE A1-3
SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION
GROUNDWATER

Olin Corporation
Wilmington, MA Facility

HHEPC#	LOCATION	SAMPLENUM	DATE TAKEN
100	GW-54-S	1000215	03-Nov-92
100	GW-55-D	1000056	10-Dec-91
100	GW-55-D	1000198	02-Nov-92
100	GW-55-S	1000045	01-Aug-91
100	GW-55-S	1000199	02-Nov-92
100	GW-55-S	1460753	01-May-96
100	GW-55-S	1461234	23-Oct-96
100	GW-56-D	1000046	01-Aug-91
100	GW-56-D	1000200	02-Nov-92
100	GW-56-S	1000201	02-Nov-92
100	GW-56-S	1460413	04-May-95
100	GW-56-S	1460458	19-Jul-95
100	GW-68-BR	1000324	17-Dec-92
100	GW-68-BR	1460253	13-Jan-95
100	GW-68-D	1000260	11-Nov-92
100	GW-69-D	1000282	16-Nov-92
100	GW-69-S	1000283	16-Nov-92
100	GW-69-S	1461273	16-Oct-96
100	GW-75-S	1000396	07-May-93
100	GW-75-S	1000397	07-May-93
100	GW-76-S	1460667	18-Oct-95
100	GW-76-S	1461391	17-Dec-96
100	GW-76-S	1461392	17-Dec-96
100	GW-77-S	1460663	18-Oct-95
100	GW-77-S	1461393	17-Dec-96
100	GW-77-S	1461394	17-Dec-96
100	GW-78-S	1460669	18-Oct-95
100	GW-78-S	1461395	17-Dec-96
100	GW-78-S	1461396	17-Dec-96
100	GW-79-S	1460670	18-Oct-95
100	GW-79-S	1461397	17-Dec-96
100	GW-79-S	1461398	17-Dec-96
100	MP-1#01	1460894	23-May-96
100	MP-1#01	1460948	23-May-96
100	MP-1#02	1460895	23-May-96
100	MP-1#02	1460949	23-May-96
100	MP-1#03	1460896	23-May-96
100	MP-1#03	1460950	23-May-96
100	MP-1#04	1460893	23-May-96
100	MP-1#04	1460947	23-May-96
100	MP-1#05	1460898	23-May-96
100	MP-1#05	1460952	23-May-96
100	MP-2#01	1460862	20-May-96
100	MP-2#01	1460916	20-May-96
100	MP-2#02	1460861	20-May-96
100	MP-2#02	1460915	20-May-96
100	MP-2#03	1460860	20-May-96
100	MP-2#03	1460914	20-May-96
100	MP-2#04	1460859	20-May-96
100	MP-2#04	1460913	20-May-96

TABLE A1-3			
SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION			
GROUNDWATER			
Olin Corporation			
Wilmington, MA Facility			
HHEPC#	LOCATION	SAMPLENUM	DATE TAKEN
100	SL-02	1461372	17-Dec-96
100	SL-03	1461373	17-Dec-96
100	SL-05	1000057	10-Dec-91
100	SL-05	1461374	17-Dec-96
100	SL-06	1000243	09-Nov-92
100	SL-06	1002263	21-Nov-90
100	SL-06	1461375	17-Dec-96
Plant B Samples (interceptor wells and associated monitoring wells with organics)			
102	GW-16	1000933	01-May-90
102	GW-52-D	1000038	03-Nov-92
102	GW-52-D	1000210	03-Nov-92
102	GW-52-S	1000039	01-Aug-91
102	GW-52-S	1000211	03-Nov-92
102	GW-53-D	1000040	01-Aug-91
102	GW-53-D	1000212	03-Nov-92
102	IW-04	1000250	10-Nov-92
102	IW-11	1000167	12-Aug-92
102	IW-11	1461381	18-Dec-96
102	IW-11	1461580	24-Jan-97
102	IW-11	1461581	24-Jan-97
102	IW-12	1461382	18-Dec-96
102	IW-12	1461387	18-Dec-96
102	IW-12	1461582	24-Jan-97
102	IW-12	1461583	24-Jan-97
102	IW-13	1461383	18-Dec-96
102	IW-13	1461584	24-Jan-97
102	IW-13	1461585	24-Jan-97
All Zone 2 Samples			
103			
103	BUTTERS ROW 1	1460001	10-Sep-92
103	BUTTERS ROW 1	1461098	31-Jul-96
103	BUTTERS ROW 1	1461539	23-Jan-97
103	BRTP*	970923A-01	24-Apr-97
103	CHESTNUT ST 1	1460004	03-Sep-92
103	CHESTNUT ST 1	1460974	19-Jun-96
103	CHESTNUT ST 1	1461095	31-Jul-96
103	CHESTNUT ST 1	1461541	23-Jan-97
103	GW-01	1000922	01-May-90
103	GW-13	1000930	01-May-90
103	GW-14	1000931	01-May-90
103	GW-15	1000932	01-May-90
103	GW-31-D	1000048	06-Dec-91
103	GW-31-D	1000194	02-Nov-92
103	GW-31-S	1000195	02-Nov-92
103	GW-32-D	1000196	02-Nov-92
103	GW-32-S	1000284	17-Nov-92
103	GW-44-D	1000246	10-Nov-92

TABLE A1-3			
SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION			
GROUNDWATER			
Olin Corporation			
Wilmington, MA Facility			
HHEPC#	LOCATION	SAMPLENUM	DATE TAKEN
103	GW-44-D	1460607	17-Oct-95
103	GW-44-S	1000247	10-Nov-92
103	GW-44-S	1460606	17-Oct-95
103	GW-44-S	1461270	17-Oct-96
103	GW-44-S	1461307	17-Oct-96
103	GW-53-S	1000041	01-Aug-91
103	GW-53-S	1000213	03-Nov-92
103	GW-58-D	1000264	12-Nov-92
103	GW-58-D	1460196	12-Jan-95
103	GW-58-D	1460556	16-Oct-95
103	GW-58-S	1000265	12-Nov-92
103	GW-58-S	1460557	16-Oct-95
103	GW-58-S	1460558	16-Oct-95
103	GW-59-D	1000066	08-Feb-92
103	GW-59-D	1000248	10-Nov-92
103	GW-59-S	1000067	08-Feb-92
103	GW-59-S	1000249	10-Nov-92
103	GW-62-BR	1000300	19-Nov-92
103	GW-62-BR	1460560	16-Oct-95
103	GW-62-BRD	1460995	07-Jan-93
103	GW-62-D	1000279	16-Nov-92
103	GW-62-D	1461111	01-Aug-96
103	GW-62-D	1461112	01-Aug-96
103	GW-62-D	1461545	23-Jan-97
103	GW-62-M	1000280	16-Nov-92
103	GW-62-M	1461110	01-Aug-96
103	GW-62-M	1461544	23-Jan-97
103	GW-62-S	1000281	16-Nov-92
103	GW-62-S	1461109	01-Aug-96
103	GW-62-S	1461543	23-Jan-97
103	GW-64-D	1000295	18-Nov-92
103	GW-64-D	1461102	31-Jul-96
103	GW-64-D	1461105	31-Jul-96
103	GW-64-D	1461549	23-Jan-97
103	GW-64-D	1461552	23-Jan-97
103	GW-64-S	1000296	18-Nov-92
103	GW-64-S	1461101	31-Jul-96
103	GW-64-S	1461548	23-Jan-97
103	GW-70-D	1000268	12-Nov-92
103	GW-70-S	1000269	12-Nov-92
103	GW-83-D	1461557	20-Jan-97
103	GW-83-D	1461295	26-Oct-96
103	GW-83-M	1461296	26-Oct-96
103	GW-83-M	1461556	20-Jan-97
103	GW-83-S	1461297	26-Oct-96
103	GW-83-S	1461555	19-Jan-97
103	GW-84-D	1461416	20-Dec-96
103	GW-84-D	1461559	20-Jan-97
103	GW-84-M	1461415	20-Dec-96
103	GW-84-M	1461565	22-Jan-97

TABLE A1-3			
SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION			
GROUNDWATER			
Olin Corporation			
Wilmington, MA Facility			
HHEPC#	LOCATION	SAMPLENUM	DATE TAKEN
103	GW-84-S	1461414	20-Dec-96
103	GW-84-S	1461558	20-Jan-97
103	GW-85-D	1461350	19-Nov-96
103	GW-85-D	1461566	21-Jan-97
103	GW-85-M	1461348	19-Nov-96
103	GW-85-M	1461349	19-Nov-96
103	GW-85-M	1461567	21-Jan-97
103	GW-86-D	1461409	19-Dec-96
103	GW-86-D	1461563	22-Jan-97
103	GW-86-M	1461407	19-Dec-96
103	GW-86-M	1461562	22-Jan-97
103	GW-86-S	1461405	19-Dec-96
103	GW-86-S	1461561	22-Jan-97
103	GW-87-D	1461410	19-Dec-96
103	GW-87-D	1461411	19-Dec-96
103	MP-3#01	1460884	22-May-96
103	MP-3#01	1460938	22-May-96
103	MP-3#02	1460883	22-May-96
103	MP-3#02	1460937	22-May-96
103	MP-3#03	1460882	22-May-96
103	MP-3#03	1460936	22-May-96
103	MP-3#04	1460881	22-May-96
103	MP-3#04	1460935	22-May-96
103	MP-3#05	1460880	21-May-96
103	MP-3#05	1460934	21-May-96
103	MP-3#06	1460879	21-May-96
103	MP-3#06	1460933	21-May-96
Non-Zone 2 Shallow Hot Spot Samples			
101	GT-04-S	1000915	01-May-90
101	GT-06-S	1000918	01-May-90
101	GT-09-S	1000921	01-May-90
101	GW-10-S	1000006	01-Aug-91
101	GW-10-S	1000261	12-Nov-92
101	GW-10-S	1461261	17-Oct-96
101	GW-10-S	1461568	24-Jan-97
101	GW-19-S	1000938	01-May-90
101	GW-19-S	1461570	24-Jan-97
101	GW-22-S	1000223	05-Nov-92
101	GW-22-S	1000944	16-Feb-90
101	GW-22-S	1461020	02-May-96
101	GW-27-S	1000239	09-Nov-92
101	GW-27-S	1461015	01-May-96
101	GW-28-S	1000018	01-Aug-91
101	GW-28-S	1000231	06-Nov-92

TABLE A1-3			
SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION			
GROUNDWATER			
Olin Corporation			
Wilmington, MA Facility			
HHEPC#	LOCATION	SAMPLENUM	DATE TAKEN
101	GW-28-S	1461263	17-Oct-96
101	GW-28-S	1461304	17-Oct-96
101	GW-29-S	1000020	01-Aug-91
101	GW-29-S	1000233	06-Nov-92
101	GW-33-S	1000207	03-Nov-92
101	GW-33-S	1000966	16-Feb-90
101	GW-34-S	1000225	05-Nov-92
101	GW-34-S	1000847	16-Feb-90
101	GW-34-S	1461018	02-May-96
101	GW-35-S	1000227	05-Nov-92
101	GW-35-S	1000851	16-Feb-90
101	GW-35-S	1461017	01-May-96
101	GW-35-S	1461574	24-Jan-97
101	GW-43-S	1000259	11-Nov-92
101	GW-43-S	1460613	17-Oct-95
101	GW-43-S	1461264	16-Oct-96
101	GW-43-S	1461577	24-Jan-97
101	GW-50-S	1000217	04-Nov-92
101	GW-50-S	1460654	18-Oct-95
101	GW-50-S	1460671	18-Oct-95
101	GW-54-S	1000043	01-Aug-91
101	GW-54-S	1000215	03-Nov-92
101	GW-76-S	1460667	18-Oct-95
101	GW-76-S	1461391	17-Dec-96
101	GW-76-S	1461392	17-Dec-96
101	GW-78-S	1460669	18-Oct-95
101	GW-78-S	1461395	17-Dec-96
101	GW-78-S	1461396	17-Dec-96
101	GW-79-S	1460670	18-Oct-95
101	GW-79-S	1461397	17-Dec-96
101	GW-79-S	1461398	17-Dec-96
Zone 2 Dense Layer Hot Spot Samples			
105	GW-44-D	1000246	10-Nov-92
105	GW-44-D	1460607	17-Oct-95
105	GW-58-D	1000264	12-Nov-92
105	GW-58-D	1460196	12-Jan-95
105	GW-58-D	1460556	16-Oct-95
105	GW-59-D	1000066	08-Feb-92
105	GW-59-D	1000248	10-Nov-92

TABLE A1-3
SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION
GROUNDWATER

Olin Corporation
Wilmington, MA Facility

HHEPC#	LOCATION	SAMPLENUM	DATE TAKEN
105	GW-62-BR	1000300	19-Nov-92
105	GW-62-BR	1460560	16-Oct-95
105	GW-70-D	1000268	12-Nov-92
105	GW-83-D	1461557	20-Jan-97
105	GW-83-D	1461295	26-Oct-96
105	MP-3#01	1460884	22-May-96
105	MP-3#01	1460938	22-May-96
105	MP-3#02	1460883	22-May-96
105	MP-3#02	1460937	22-May-96
105	MP-3#03	1460882	22-May-96
105	MP-3#03	1460936	22-May-96
105	MP-3#04	1460881	22-May-96
105	MP-3#04	1460935	22-May-96
105	MP-3#05	1460880	21-May-96
105	MP-3#05	1460934	21-May-96
105	MP-3#06	1460879	21-May-96
105	MP-3#06	1460933	21-May-96
Zone 2 Samples (excluding dense layer hot spot)			
106	BUTTERS ROW 1	1460001	10-Sep-92
106	BUTTERS ROW 1	1461098	31-Jul-96
106	BUTTERS ROW 1	1461539	23-Jan-97
106	BRTP*	970923A-01	24-Apr-97
106	CHESTNUT ST 1	1460004	03-Sep-92
106	CHESTNUT ST 1	1460974	19-Jun-96
106	CHESTNUT ST 1	1461095	31-Jul-96
106	CHESTNUT ST 1	1461541	23-Jan-97
106	GW-01	1000922	01-May-90
106	GW-13	1000930	01-May-90
106	GW-14	1000931	01-May-90
106	GW-15	1000932	01-May-90
106	GW-31-D	1000048	06-Dec-91
106	GW-31-D	1000194	02-Nov-92
106	GW-31-S	1000195	02-Nov-92
106	GW-32-D	1000196	02-Nov-92
106	GW-32-S	1000284	17-Nov-92
106	GW-44-S	1000247	10-Nov-92
106	GW-44-S	1460606	17-Oct-95
106	GW-44-S	1461270	17-Oct-96
106	GW-44-S	1461307	17-Oct-96

TABLE A1-3

SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION

GROUNDWATER

Olin Corporation

Wilmington, MA Facility

HHEPC#	LOCATION	SAMPLENUM	DATE TAKEN
106	GW-53-S	1000041	01-Aug-91
106	GW-53-S	1000213	03-Nov-92
106	GW-58-S	1000265	12-Nov-92
106	GW-58-S	1460557	16-Oct-95
106	GW-58-S	1460558	16-Oct-95
106	GW-59-S	1000067	08-Feb-92
106	GW-59-S	1000249	10-Nov-92
106	GW-62-BRD	1460995	07-Jan-93
106	GW-62-D	1000279	16-Nov-92
106	GW-62-D	1461111	01-Aug-96
106	GW-62-D	1461112	01-Aug-96
106	GW-62-D	1461545	23-Jan-97
106	GW-62-M	1000280	16-Nov-92
106	GW-62-M	1461110	01-Aug-96
106	GW-62-M	1461544	23-Jan-97
106	GW-62-S	1000281	16-Nov-92
106	GW-62-S	1461109	01-Aug-96
106	GW-62-S	1461543	23-Jan-97
106	GW-64-D	1000295	18-Nov-92
106	GW-64-D	1461102	31-Jul-96
106	GW-64-D	1461105	31-Jul-96
106	GW-64-D	1461549	23-Jan-97
106	GW-64-D	1461552	23-Jan-97
106	GW-64-S	1000296	18-Nov-92
106	GW-64-S	1461101	31-Jul-96
106	GW-64-S	1461548	23-Jan-97
106	GW-70-S	1000269	12-Nov-92
106	GW-83-M	1461296	26-Oct-96
106	GW-83-M	1461556	20-Jan-97
106	GW-83-S	1461297	26-Oct-96
106	GW-83-S	1461555	19-Jan-97
106	GW-84-D	1461416	20-Dec-96
106	GW-84-D	1461559	20-Jan-97
106	GW-84-M	1461415	20-Dec-96
106	GW-84-M	1461565	22-Jan-97
106	GW-84-S	1461414	20-Dec-96
106	GW-84-S	1461558	20-Jan-97
106	GW-85-D	1461350	19-Nov-96
106	GW-85-D	1461566	21-Jan-97
106	GW-85-M	1461348	19-Nov-96
106	GW-85-M	1461349	19-Nov-96

TABLE A1-3			
SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION			
GROUNDWATER			
Olin Corporation			
Wilmington, MA Facility			
HHEPC#	LOCATION	SAMPLENUM	DATE TAKEN
106	GW-85-M	1461567	21-Jan-97
106	GW-86-D	1461409	19-Dec-96
106	GW-86-D	1461563	22-Jan-97
106	GW-86-M	1461407	19-Dec-96
106	GW-86-M	1461562	22-Jan-97
106	GW-86-S	1461405	19-Dec-96
106	GW-86-S	1461561	22-Jan-97
106	GW-87-D	1461410	19-Dec-96
106	GW-87-D	1461411	19-Dec-96
Non-Zone 2 Samples (excluding shallow hot spot and dense layer hot spot)			
107	GT-04-D	1000914	01-May-90
107	GT-05	1000916	01-May-90
107	GT-06-D	1000917	01-May-90
107	GT-07	1000919	01-May-90
107	GT-09-D	1000920	01-May-90
107	GW-03-D	1000001	01-Aug-91
107	GW-03-D	1000218	05-Nov-92
107	GW-03-S	1000002	01-Aug-91
107	GW-03-S	1000219	05-Nov-92
107	GW-04	1000003	01-Aug-91
107	GW-04	1000220	05-Nov-92
107	GW-04-D	1000004	01-Aug-91
107	GW-04-D	1000221	05-Nov-92
107	GW-05	1000875	01-May-90
107	GW-06-D	1000202	03-Nov-92
107	GW-06-S	1000203	03-Nov-92
107	GW-08	1460457	19-Jul-95
107	GW-08	1460469	19-Jul-95
107	GW-11	1000007	01-Aug-91
107	GW-11	1000235	09-Nov-92
107	GW-11	1461569	24-Jan-97
107	GW-17-D	1000009	01-Aug-91
107	GW-17-D	1000204	03-Nov-92
107	GW-17-D	1461014	01-May-96
107	GW-17-S	1000010	01-Aug-91
107	GW-17-S	1000205	03-Nov-92
107	GW-17-S	1461013	01-May-96
107	GW-18-D	1000011	01-Aug-91
107	GW-18-D	1000236	09-Nov-92

TABLE A1-3			
SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION			
GROUNDWATER			
Olin Corporation			
Wilmington, MA Facility			
HHEPC#	LOCATION	SAMPLENUM	DATE TAKEN
107	GW-19-D	1000237	09-Nov-92
107	GW-20	1000939	01-May-90
107	GW-21-D	1000012	01-Aug-91
107	GW-21-D	1000228	06-Nov-92
107	GW-21-S	1000013	01-Aug-91
107	GW-21-S	1000229	06-Nov-92
107	GW-24	1000014	01-Aug-91
107	GW-24	1461571	24-Jan-97
107	GW-25	1000015	01-Aug-91
107	GW-25	1000275	16-Nov-92
107	GW-25	1461262	17-Oct-96
107	GW-25	1461572	13-Oct-95
107	GW-26	1000016	01-Aug-91
107	GW-26	1000270	13-Nov-92
107	GW-26	1461573	24-Jan-97
107	GW-28-D	1000017	01-Aug-91
107	GW-28-D	1000230	06-Nov-92
107	GW-29-D	1000019	01-Aug-91
107	GW-29-D	1000232	06-Nov-92
107	GW-33-D	1000206	03-Nov-92
107	GW-33-D	1000964	16-Feb-90
107	GW-34-D	1000224	05-Nov-92
107	GW-34-D	1000968	16-Feb-90
107	GW-34-D	1461019	02-May-96
107	GW-39	1000024	01-Aug-91
107	GW-39	1000253	11-Nov-92
107	GW-39	1461575	13-Oct-95
107	GW-40-D	1000254	11-Nov-92
107	GW-40-D	1460621	17-Oct-95
107	GW-40-D	1460637	17-Oct-95
107	GW-40-S	1000255	11-Nov-92
107	GW-40-S	1460620	17-Oct-95
107	GW-40-S	1460636	17-Oct-95
107	GW-42-S	1000257	11-Nov-92
107	GW-42-S	1460664	18-Oct-95
107	GW-42-S	1461265	16-Oct-96
107	GW-42-S	1461576	24-Jan-97
107	GW-45-S	1000263	12-Nov-92
107	GW-45-S	1460608	17-Oct-95
107	GW-45-S	1461271	17-Oct-96
107	GW-45-S	1461308	17-Oct-96

TABLE A1-3			
SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION			
GROUNDWATER			
Olin Corporation			
Wilmington, MA Facility			
HHEPC#	LOCATION	SAMPLENUM	DATE TAKEN
107	GW-50-D	1000216	04-Nov-92
107	GW-50-D	1460194	12-Jan-95
107	GW-50-D	1460619	17-Oct-95
107	GW-51-D	1000036	01-Aug-91
107	GW-51-D	1000208	03-Nov-92
107	GW-51-S	1000037	01-Aug-91
107	GW-51-S	1000209	03-Nov-92
107	GW-54-D	1000042	01-Aug-91
107	GW-54-D	1000214	03-Nov-92
107	GW-54-D	1000372	01-Aug-91
107	GW-55-S	1000045	01-Aug-91
107	GW-55-S	1000199	02-Nov-92
107	GW-55-S	1460753	01-May-96
107	GW-55-S	1461234	23-Oct-96
107	GW-56-D	1000046	01-Aug-91
107	GW-56-D	1000200	02-Nov-92
107	GW-56-S	1000201	02-Nov-92
107	GW-56-S	1460413	04-May-95
107	GW-56-S	1460458	19-Jul-95
107	GW-68-BR	1000324	17-Dec-92
107	GW-68-BR	1460253	13-Jan-95
107	GW-68-D	1000260	11-Nov-92
107	GW-69-S	1000283	16-Nov-92
107	GW-69-S	1461273	16-Oct-96
107	GW-75-S	1000396	07-May-93
107	GW-75-S	1000397	07-May-93
107	GW-77-S	1460663	18-Oct-95
107	GW-77-S	1461393	17-Dec-96
107	GW-77-S	1461394	17-Dec-96
107	SL-02	1461372	17-Dec-96
107	SL-03	1461373	17-Dec-96
107	SL-05	1000057	10-Dec-91
107	SL-05	1461374	17-Dec-96
107	SL-06	1000243	09-Nov-92
107	SL-06	1002263	21-Nov-90
107	SL-06	1461375	17-Dec-96
Non-Zone 2 Dense Layer Hot Spot Samples			
108	GW-07	1461377	18-Dec-96
108	GW-10-D	1000005	01-Aug-91

TABLE A1-3			
SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION			
GROUNDWATER			
Olin Corporation			
Wilmington, MA Facility			
HHEPC#	LOCATION	SAMPLENUM	DATE TAKEN
108	GW-10-D	1000234	09-Nov-92
108	GW-22-D	1000942	16-Feb-90
108	GW-22-D	1000222	05-Nov-92
108	GW-22-D	1461022	02-May-96
108	GW-27-D	1000238	09-Nov-92
108	GW-27-D	1460255	13-Jan-95
108	GW-27-D	1461016	01-May-96
108	GW-30-DR	1000958	16-Feb-90
108	GW-30-DR	1000240	09-Nov-92
108	GW-35-D	1000849	16-Feb-90
108	GW-35-D	1000226	05-Nov-92
108	GW-35-D	1000245	10-Nov-92
108	GW-35-D	1461023	02-May-96
108	GW-36	1000052	10-Dec-91
108	GW-36	1000276	16-Nov-92
108	GW-36	1461024	02-May-96
108	GW-36	1461314	13-Jan-95
108	GW-37	1000022	01-Aug-91
108	GW-37	1000277	16-Nov-92
108	GW-37	1461025	02-May-96
108	GW-38	1000023	01-Aug-91
108	GW-38	1000241	09-Nov-92
108	GW-42-D	1000256	11-Nov-92
108	GW-42-D	1460193	11-Jan-95
108	GW-42-D	1460611	17-Oct-95
108	GW-43-D	1000258	11-Nov-92
108	GW-43-D	1460616	17-Oct-95
108	GW-45-D	1000262	12-Nov-92
108	GW-45-D	1460609	17-Oct-95
108	GW-55-D	1000056	10-Dec-91
108	GW-55-D	1000198	02-Nov-92
108	GW-69-D	1000282	16-Nov-92
108	MP-1#01	1460894	23-May-96
108	MP-1#01	1460948	23-May-96
108	MP-1#02	1460895	23-May-96
108	MP-1#02	1460949	23-May-96
108	MP-1#03	1460896	23-May-96
108	MP-1#03	1460950	23-May-96
108	MP-1#04	1460893	23-May-96
108	MP-1#04	1460947	23-May-96
108	MP-1#05	1460898	23-May-96

TABLE A1-3			
SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION			
GROUNDWATER			
Olin Corporation			
Wilmington, MA Facility			
HHEPC#	LOCATION	SAMPLENUM	DATE TAKEN
108	MP-1#05	1460952	23-May-96
108	MP-2#01	1460862	20-May-96
108	MP-2#01	1460916	20-May-96
108	MP-2#02	1460861	20-May-96
108	MP-2#02	1460915	20-May-96
108	MP-2#03	1460860	20-May-96
108	MP-2#03	1460914	20-May-96
108	MP-2#04	1460859	20-May-96
108	MP-2#04	1460913	20-May-96
* BRTP = BUTTERS ROW TREATMENT PLANT			

TABLE A1-4										
SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION										
SURFACE WATER										
Olin Corporation										
Wilmington, MA Facility										
LOCATION	OUR LOCATION	SAMPLENUM	GROUP	MATRIXTYPE	DATE TAKEN		MA BLANK	QAQC TYPE	COMMENT	HHRPC#
CURRENT UNFILT NEW										
SW-15	GSW-15	1460405	F,I,M,O	SW	03-May-95	N	FALSE			19
SO. DITCH POND	GSW-P	1460824	F,I,M,O	SW	19-Apr-96	N	FALSE			20
SW-16	SW-9	1460661	F,I,M,O	SW	18-Oct-95	N	FALSE			20
SW-17	SW-11	1460659	F,I,M,O	SW	18-Oct-95	N	FALSE			20
SW-18	GSW-18	1460415	F,I,M,O	SW	04-May-95	N	FALSE			20
SW-17	SW-11	1460660	F,I,M,O	SW	18-Oct-95	N	FALSE	FIELD DUPLICATE	DUP OF 1460659	20
SW-11	SW-15	1460406	F,I,M,O	SW	03-May-95	N	FALSE			21
SW-12	GSW-12	1460656	F,I,M,O	SW	18-Oct-95	N	FALSE			21
SW-14	SW-18	1460655	F,I,M,O	SW	18-Oct-95	N	FALSE			21
OLD UNFILT CURRENT										
SW-01	SW-01	1000301	ALL	SW	30-Nov-92		FALSE			22
SW-02	SW-02	1000302	ALL	SW	30-Nov-92		FALSE			22
SW-03	SW-03	1000303	ALL	SW	30-Nov-92		FALSE			22
SW-04	SW-04	1000304	ALL	SW	30-Nov-92		FALSE			22
SW-05	SW-05	1000305	ALL	SW	30-Nov-92		FALSE			22
SW-06	SW-06	1000306	ALL	SW	01-Dec-92		FALSE			22
SW-23	SW-23	1000322	ALL	SW	02-Dec-92		FALSE			22
SW-24	SW-24	1461046	ALL	SW	07-Jan-93		FALSE			22
SW-25	SW-25	1461047	ALL	SW	25-Mar-93		FALSE			22
SW-26	SW-26	1461048	ALL	SW	25-Mar-93		FALSE			22
SW-27	SW-27	1461049	ALL	SW	25-Mar-93		FALSE			22
SW-28	SW-28	1461050	ALL	SW	25-Mar-93		FALSE			22
SW-06	SW-06	1000387	ALL	SW	01-Dec-92		FALSE	FIELD DUPLICATE	DUP OF 1000306	22
SW-07	SW-07	1000307	ALL	SW	01-Dec-92		FALSE			23
SW-08	SW-08	1000308	ALL	SW	01-Dec-92		FALSE			23
SW-09	SW-09	1000309	ALL	SW	01-Dec-92		FALSE			23
SW-10	SW-10	1000310	ALL	SW	01-Dec-92		FALSE			23
SW-11	SW-11	1000311	ALL	SW	01-Dec-92		FALSE			23
SW-12	SW-12	1000312	ALL	SW	01-Dec-92		FALSE			23
SW-13	SW-13	1000313	ALL	SW	01-Dec-92		FALSE			23
SW-14	SW-14	1000314	ALL	SW	01-Dec-92		FALSE			23
SW-19	SW-19	1000323	ALL	SW	03-Dec-92		FALSE			23
SW-20	SW-20	1000315	ALL	SW	01-Dec-92		FALSE			23
SW-21	SW-21	1000316	ALL	SW	01-Dec-92		FALSE			23
SW-22	SW-22	1000317	ALL	SW	01-Dec-92		FALSE			23
SW-15	SW-15	1000318	ALL	SW	02-Dec-92		FALSE			24
SW-16	SW-16	1000319	ALL	SW	02-Dec-92		FALSE			24
SW-17	SW-17	1000320	ALL	SW	02-Dec-92		FALSE			24
SW-18	SW-18	1000321	ALL	SW	02-Dec-92		FALSE			24
SW-17	SW-17	1000388	ALL	SW	02-Dec-92		FALSE	FIELD DUPLICATE	DUP OF 1000320	24
SW-15 (TAKE OUT PAHs)	SW-15	1000318	ALL	SW	02-Dec-92		FALSE			29
SW-16	SW-16	1000319	ALL	SW	02-Dec-92		FALSE			29

TABLE A1-4										
SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION										
SURFACE WATER										
Olin Corporation										
Wilmington, MA Facility										
LOCATION	OUR LOCATION	SAMPLENUM	GROUP	MATRIXTYPE	DATE TAKEN		ISA BLANK	QAQC TYPE	COMMENT	HHRPC4
SW-17	SW-17	1000320	ALL	SW	02-Dec-92		FALSE			29
SW-18	SW-18	1000321	ALL	SW	02-Dec-92		FALSE			29
SW-17	SW-17	1000388	ALL	SW	02-Dec-92		FALSE	FIELD DUPLICATE	DUP OF 1000320	29

TABLE A1-4										
SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION										
SURFACE WATER										
Olin Corporation										
Wilmington, MA Facility										
LOCATION	OUR LOCATION	SAMPLENUM	GROUP	MATRIXTYPE	DATE TAKEN		ISA BLANK	QAQC TYPE	COMMENT	HHEPC#
ALL SAMPLES - OLD (UNFILTERED)										
SW-01	SW-01	1000301	ALL	SW	30-Nov-92		FALSE			25
SW-02	SW-02	1000302	ALL	SW	30-Nov-92		FALSE			25
SW-03	SW-03	1000303	ALL	SW	30-Nov-92		FALSE			25
SW-04	SW-04	1000304	ALL	SW	30-Nov-92		FALSE			25
SW-05	SW-05	1000305	ALL	SW	30-Nov-92		FALSE			25
SW-06	SW-06	1000306	ALL	SW	01-Dec-92		FALSE			25
SW-23	SW-23	1000322	ALL	SW	02-Dec-92		FALSE			25
SW-24	SW-24	1461046	ALL	SW	07-Jan-93		FALSE			25
SW-25	SW-25	1461047	ALL	SW	25-Mar-93		FALSE			25
SW-26	SW-26	1461048	ALL	SW	25-Mar-93		FALSE			25
SW-27	SW-27	1461049	ALL	SW	25-Mar-93		FALSE			25
SW-28	SW-28	1461050	ALL	SW	25-Mar-93		FALSE			25
SW-06	SW-06	1000387	ALL	SW	01-Dec-92		FALSE	FIELD DUPLICATE	DUP OF 1000306	25
SW-07	SW-07	1000307	ALL	SW	01-Dec-92		FALSE			25
SW-08	SW-08	1000308	ALL	SW	01-Dec-92		FALSE			25
SW-09	SW-09	1000309	ALL	SW	01-Dec-92		FALSE			25
SW-10	SW-10	1000310	ALL	SW	01-Dec-92		FALSE			25
SW-11	SW-11	1000311	ALL	SW	01-Dec-92		FALSE			25
SW-12	SW-12	1000312	ALL	SW	01-Dec-92		FALSE			25
SW-13	SW-13	1000313	ALL	SW	01-Dec-92		FALSE			25
SW-14	SW-14	1000314	ALL	SW	01-Dec-92		FALSE			25
SW-19	SW-19	1000323	ALL	SW	03-Dec-92		FALSE			25
SW-20	SW-20	1000315	ALL	SW	01-Dec-92		FALSE			25
SW-21	SW-21	1000316	ALL	SW	01-Dec-92		FALSE			25
SW-22	SW-22	1000317	ALL	SW	01-Dec-92		FALSE			25
SW-15	SW-15	1000318	ALL	SW	02-Dec-92		FALSE			25
SW-16	SW-16	1000319	ALL	SW	02-Dec-92		FALSE			25
SW-17	SW-17	1000320	ALL	SW	02-Dec-92		FALSE			25
SW-18	SW-18	1000321	ALL	SW	02-Dec-92		FALSE			25
SW-17	SW-17	1000388	ALL	SW	02-Dec-92		FALSE	FIELD DUPLICATE	DUP OF 1000320	25

TABLE A1-4										
SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION										
SURFACE WATER										
Olin Corporation										
Wilmington, MA Facility										
LOCATION	OUR LOCATION	SAMPLENUM	GROUP	MATRIXTYPE	DATE TAKEN		MA BLANK	QAQC TYPE	COMMENT	HHEPC#
ALL NEW UNFILTERED										
SW-15	GSW-15	1460405	F,I,M,O	SW	03-May-95	N	FALSE			26
SO. DITCH POND	GSW-P	1460824	F,I,M,O	SW	19-Apr-96	N	FALSE			26
SW-16	SW-9	1460661	F,I,M,O	SW	18-Oct-95	N	FALSE			26
SW-17	SW-11	1460659	F,I,M,O	SW	18-Oct-95	N	FALSE			26
SW-18	GSW-18	1460415	F,I,M,O	SW	04-May-95	N	FALSE			26
SW-17	SW-11	1460660	F,I,M,O	SW	18-Oct-95	N	FALSE	FIELD DUPLICATE	DUP OF 1460659	26
SW-11	SW-15	1460406	F,I,M,O	SW	03-May-95	N	FALSE			26
SW-12	GSW-12	1460656	F,I,M,O	SW	18-Oct-95	N	FALSE			26
SW-14	SW-18	1460655	F,I,M,O	SW	18-Oct-95	N	FALSE			26
OLD UNFILTERED HOT/NOT HOT										
SW-04	SW-04	1000304	ALL	SW	30-Nov-92		FALSE			27
SW-05	SW-05	1000305	ALL	SW	30-Nov-92		FALSE			27
SW-06	SW-06	1000306	ALL	SW	01-Dec-92		FALSE			27
SW-23	SW-23	1000322	ALL	SW	02-Dec-92		FALSE			27
SW-24	SW-24	1461046	ALL	SW	07-Jan-93		FALSE			27
SW-25	SW-25	1461047	ALL	SW	25-Mar-93		FALSE			27
SW-26	SW-26	1461048	ALL	SW	25-Mar-93		FALSE			27
SW-27	SW-27	1461049	ALL	SW	25-Mar-93		FALSE			27
SW-28	SW-28	1461050	ALL	SW	25-Mar-93		FALSE			27
SW-06	SW-06	1000387	ALL	SW	01-Dec-92		FALSE	FIELD DUPLICATE	DUP OF 1000306	27
SW-07	SW-07	1000307	ALL	SW	01-Dec-92		FALSE			27
SW-08	SW-08	1000308	ALL	SW	01-Dec-92		FALSE			27
SW-09	SW-09	1000309	ALL	SW	01-Dec-92		FALSE			27
SW-10	SW-10	1000310	ALL	SW	01-Dec-92		FALSE			27
SW-11	SW-11	1000311	ALL	SW	01-Dec-92		FALSE			27
SW-14	SW-14	1000314	ALL	SW	01-Dec-92		FALSE			27
SW-15	SW-15	1000318	ALL	SW	02-Dec-92		FALSE			27
SW-16	SW-16	1000319	ALL	SW	02-Dec-92		FALSE			27
SW-17	SW-17	1000320	ALL	SW	02-Dec-92		FALSE			27
SW-18	SW-18	1000321	ALL	SW	02-Dec-92		FALSE			27
SW-17	SW-17	1000388	ALL	SW	02-Dec-92		FALSE	FIELD DUPLICATE	DUP OF 1000320	27
SW-01	SW-01	1000301	ALL	SW	30-Nov-92		FALSE			28
SW-02	SW-02	1000302	ALL	SW	30-Nov-92		FALSE			28
SW-03	SW-03	1000303	ALL	SW	30-Nov-92		FALSE			28
SW-12	SW-12	1000312	ALL	SW	01-Dec-92		FALSE			28
SW-19	SW-19	1000323	ALL	SW	03-Dec-92		FALSE			28

TABLE A1-4										
SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION										
SURFACE WATER										
Olin Corporation										
Wilmington, MA Facility										
LOCATION	OUR LOCATION	SAMPLENUM	GROUP	MATRIXTYPE	DATE TAKEN		MA BLANK	QAQC TYPE	COMMENT	HHRPC#
SW-20	SW-20	1000315	ALL	SW	01-Dec-92		FALSE			28
SW-21	SW-21	1000316	ALL	SW	01-Dec-92		FALSE			28
SW-22	SW-22	1000317	ALL	SW	01-Dec-92		FALSE			28
SW-13	SW-13	1000313	ALL	SW	01-Dec-92		FALSE			27

TABLE A1-5							
SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION							
SEDIMENT							
Olin Corporation							
Wilmington, MA Facility							
LOCATION	SAMPLENUM	MATRIXTYPE	DATE TAKEN	ISA BLANK	QAQC TYPE	COMMENT	HHEPC#
current by area							
SW-01	1000328	SD	31-Aug-92	FALSE			30
SW-01	1000329	SD	30-Nov-92	FALSE			30
SW-02	1000330	SD	31-Aug-92	FALSE			30
SW-02	1000331	SD	30-Nov-92	FALSE			30
SW-03	1000332	SD	31-Aug-92	FALSE			30
SW-03	1000333	SD	30-Nov-92	FALSE			30
SW-04	1000334	SD	31-Aug-92	FALSE			30
SW-04	1000335	SD	30-Nov-92	FALSE			30
SW-05	1000336	SD	31-Aug-92	FALSE			30
SW-05	1000337	SD	30-Nov-92	FALSE			30
SW-06	1000338	SD	31-Aug-92	FALSE			30
SW-06	1000339	SD	01-Dec-92	FALSE			30
SW-06	1000389	SD	01-Dec-92	FALSE	FIELD DUPLICATE	DUP OF 1000339	30
SW-23	1000368	SD	02-Dec-92	FALSE			30
SW-24	1461040	SD	07-Jan-93	FALSE			30
SW-25	1461041	SD	25-Mar-93	FALSE			30
SW-26	1461042	SD	25-Mar-93	FALSE			30
SW-27	1461043	SD	25-Mar-93	FALSE			30
SW-29	1461044	SD	20-Apr-93	FALSE			30
BS008SD	1461516	SD	20-Jan-97	FALSE			31
BS009PND	1461517	SD	20-Jan-97	FALSE			31
BS010PND	1461518	SD	20-Jan-97	FALSE			31
BS011WMD	1461519	SD	20-Jan-97	FALSE			31
POND	1460672	SD	13-Sep-95	FALSE			31
SW-07	1000341	SD	01-Dec-92	FALSE			31
SW-08	1000342	SD	01-Sep-92	FALSE			31
SW-08	1000343	SD	01-Dec-92	FALSE			31
SW-09	1000344	SD	01-Sep-92	FALSE			31
SW-09	1000345	SD	01-Dec-92	FALSE			31
SW-10	1000346	SD	01-Sep-92	FALSE			31

TABLE A1-5

SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION

SEDIMENT

Olin Corporation

Wilmington, MA Facility

LOCATION	SAMPLENUM	MATRIXTYPE	DATE TAKEN	ISA BLANK	QAQC TYPE	COMMENT	HHEPC#
SW-10	1000347	SD	01-Dec-92	FALSE			31
SW-11	1000348	SD	01-Sep-92	FALSE			31
SW-11	1000349	SD	01-Dec-92	FALSE			31
SW-14	1000354	SD	01-Sep-92	FALSE			31
SW-14	1000355	SD	01-Dec-92	FALSE			31
SW-19	1000193	SD	02-Sep-92	FALSE			31
SW-19	1000364	SD	03-Dec-92	FALSE			31
SW-20	1000185	SD	01-Sep-92	FALSE			31
SW-20	1000365	SD	01-Dec-92	FALSE			31
SW-21	1000186	SD	01-Sep-92	FALSE			31
SW-21	1000366	SD	01-Dec-92	FALSE			31
SW-22	1000187	SD	01-Sep-92	FALSE			31
SW-22	1000367	SD	01-Dec-92	FALSE			31
BS005WDX	1461513	SD	20-Jan-97	FALSE			31
BS006WDX	1461514	SD	20-Jan-97	FALSE			31
SW-12	1000350	SD	02-Sep-92	FALSE			31
SW-12	1000351	SD	01-Dec-92	FALSE			31
SW-13	1000352	SD	02-Sep-92	FALSE			31
SW-13	1000353	SD	01-Dec-92	FALSE			31
BS007WDO	1461515	SD	20-Jan-97	FALSE			32
SW-15	1000356	SD	02-Sep-92	FALSE			32
SW-15	1000357	SD	02-Dec-92	FALSE			32
SW-16	1000358	SD	02-Sep-92	FALSE			32
SW-16	1000359	SD	02-Dec-92	FALSE			32
SW-17	1000360	SD	01-Sep-92	FALSE			32
SW-17	1000361	SD	02-Dec-92	FALSE			32
SW-17	1000390	SD	01-Sep-92	FALSE	FIELD DUPLICATE	DUP OF 1000360	32
SW-17	1000391	SD	02-Dec-92	FALSE	FIELD DUPLICATE	DUP OF 1000361	32
SW-18	1000362	SD	02-Sep-92	FALSE			32
SW-18	1000363	SD	02-Dec-92	FALSE			32
all samples for cpc							

TABLE A1-5							
SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION							
SEDIMENT							
Olin Corporation							
Wilmington, MA Facility							
LOCATION	SAMPLENUM	MATRIXTYPE	DATE_TAKEN	ISA_BLANK	QAQC_TYPE	COMMENT	HHEPC#
SW-01	1000328	SD	31-Aug-92	FALSE			33
SW-01	1000329	SD	30-Nov-92	FALSE			33
SW-02	1000330	SD	31-Aug-92	FALSE			33
SW-02	1000331	SD	30-Nov-92	FALSE			33
SW-03	1000332	SD	31-Aug-92	FALSE			33
SW-03	1000333	SD	30-Nov-92	FALSE			33
SW-04	1000334	SD	31-Aug-92	FALSE			33
SW-04	1000335	SD	30-Nov-92	FALSE			33
SW-05	1000336	SD	31-Aug-92	FALSE			33
SW-05	1000337	SD	30-Nov-92	FALSE			33
SW-06	1000338	SD	31-Aug-92	FALSE			33
SW-06	1000339	SD	01-Dec-92	FALSE			33
SW-06	1000389	SD	01-Dec-92	FALSE	FIELD DUPLICATE	DUP OF 1000339	33
SW-23	1000368	SD	02-Dec-92	FALSE			33
SW-24	1461040	SD	07-Jan-93	FALSE			33
SW-25	1461041	SD	25-Mar-93	FALSE			33
SW-26	1461042	SD	25-Mar-93	FALSE			33
SW-27	1461043	SD	25-Mar-93	FALSE			33
SW-29	1461044	SD	20-Apr-93	FALSE			33
BS008SD	1461516	SD	20-Jan-97	FALSE			33
BS009PND	1461517	SD	20-Jan-97	FALSE			33
BS010PND	1461518	SD	20-Jan-97	FALSE			33
BS011WMD	1461519	SD	20-Jan-97	FALSE			33
POND	1460672	SD	13-Sep-95	FALSE			33
SW-07	1000341	SD	01-Dec-92	FALSE			33
SW-08	1000342	SD	01-Sep-92	FALSE			33
SW-08	1000343	SD	01-Dec-92	FALSE			33
SW-09	1000344	SD	01-Sep-92	FALSE			33
SW-09	1000345	SD	01-Dec-92	FALSE			33
SW-10	1000346	SD	01-Sep-92	FALSE			33
SW-10	1000347	SD	01-Dec-92	FALSE			33
SW-11	1000348	SD	01-Sep-92	FALSE			33
SW-11	1000349	SD	01-Dec-92	FALSE			33
SW-14	1000354	SD	01-Sep-92	FALSE			33

TABLE A1-5							
SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION							
SEDIMENT							
Olin Corporation							
Wilmington, MA Facility							
LOCATION	SAMPLENUM	MATRIXTYPE	DATE TAKEN	ISA BLANK	QAQC TYPE	COMMENT	HHEPC#
SW-14	1000355	SD	01-Dec-92	FALSE			33
SW-19	1000193	SD	02-Sep-92	FALSE			33
SW-19	1000364	SD	03-Dec-92	FALSE			33
SW-20	1000185	SD	01-Sep-92	FALSE			33
SW-20	1000365	SD	01-Dec-92	FALSE			33
SW-21	1000186	SD	01-Sep-92	FALSE			33
SW-21	1000366	SD	01-Dec-92	FALSE			33
SW-22	1000187	SD	01-Sep-92	FALSE			33
SW-22	1000367	SD	01-Dec-92	FALSE			33
BS005WDX	1461513	SD	20-Jan-97	FALSE			33
BS006WDX	1461514	SD	20-Jan-97	FALSE			33
SW-12	1000350	SD	02-Sep-92	FALSE			33
SW-12	1000351	SD	01-Dec-92	FALSE			33
SW-13	1000352	SD	02-Sep-92	FALSE			33
SW-13	1000353	SD	01-Dec-92	FALSE			33
BS007WDO	1461515	SD	20-Jan-97	FALSE			33
SW-15	1000356	SD	02-Sep-92	FALSE			33
SW-15	1000357	SD	02-Dec-92	FALSE			33
SW-16	1000358	SD	02-Sep-92	FALSE			33
SW-16	1000359	SD	02-Dec-92	FALSE			33
SW-17	1000360	SD	01-Sep-92	FALSE			33
SW-17	1000361	SD	02-Dec-92	FALSE			33
SW-17	1000390	SD	01-Sep-92	FALSE	FIELD DUPLICATE	DUP OF 1000360	33
SW-17	1000391	SD	02-Dec-92	FALSE	FIELD DUPLICATE	DUP OF 1000361	33
SW-18	1000362	SD	02-Sep-92	FALSE			33
SW-18	1000363	SD	02-Dec-92	FALSE			33
future hot vs no							
SW-04	1000334	SD	31-Aug-92	FALSE			34
SW-04	1000335	SD	30-Nov-92	FALSE			34
SW-05	1000336	SD	31-Aug-92	FALSE			34

TABLE A1-5							
SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION							
SEDIMENT							
Olin Corporation							
Wilmington, MA Facility							
LOCATION	SAMPLENUM	MATRIXTYPE	DATE TAKEN	ISA BLANK	QAQC TYPE	COMMENT	HHEPC#
SW-05	1000337	SD	30-Nov-92	FALSE			34
SW-06	1000338	SD	31-Aug-92	FALSE			34
SW-06	1000339	SD	01-Dec-92	FALSE			34
SW-06	1000389	SD	01-Dec-92	FALSE	FIELD DUPLICATE	DUP OF 1000339	34
SW-23	1000368	SD	02-Dec-92	FALSE			34
SW-24	1461040	SD	07-Jan-93	FALSE			34
SW-25	1461041	SD	25-Mar-93	FALSE			34
SW-26	1461042	SD	25-Mar-93	FALSE			34
SW-27	1461043	SD	25-Mar-93	FALSE			34
BS008SD	1461516	SD	20-Jan-97	FALSE			34
BS009PND	1461517	SD	20-Jan-97	FALSE			34
BS010PND	1461518	SD	20-Jan-97	FALSE			34
BS011WMD	1461519	SD	20-Jan-97	FALSE			34
POND	1460672	SD	13-Sep-95	FALSE			34
SW-07	1000341	SD	01-Dec-92	FALSE			34
SW-08	1000342	SD	01-Sep-92	FALSE			34
SW-08	1000343	SD	01-Dec-92	FALSE			34
SW-09	1000344	SD	01-Sep-92	FALSE			34
SW-09	1000345	SD	01-Dec-92	FALSE			34
SW-10	1000346	SD	01-Sep-92	FALSE			34
SW-10	1000347	SD	01-Dec-92	FALSE			34
SW-11	1000348	SD	01-Sep-92	FALSE			34
SW-11	1000349	SD	01-Dec-92	FALSE			34
SW-14	1000354	SD	01-Sep-92	FALSE			34
SW-14	1000355	SD	01-Dec-92	FALSE			34
BS005WDX	1461513	SD	20-Jan-97	FALSE			34
BS006WDX	1461514	SD	20-Jan-97	FALSE			34
SW-12	1000350	SD	02-Sep-92	FALSE			34

TABLE A1-5							
SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION							
SEDIMENT							
Olin Corporation							
Wilmington, MA Facility							
LOCATION	SAMPLENUM	MATRIXTYPE	DATE TAKEN	ISA BLANK	QAQC TYPE	COMMENT	HHEPC#
SW-12	1000351	SD	01-Dec-92	FALSE			34
SW-13	1000352	SD	02-Sep-92	FALSE			34
SW-13	1000353	SD	01-Dec-92	FALSE			34
BS007WDO	1461515	SD	20-Jan-97	FALSE			34
SW-15	1000356	SD	02-Sep-92	FALSE			34
SW-15	1000357	SD	02-Dec-92	FALSE			34
SW-16	1000358	SD	02-Sep-92	FALSE			34
SW-16	1000359	SD	02-Dec-92	FALSE			34
SW-17	1000360	SD	01-Sep-92	FALSE			34
SW-17	1000361	SD	02-Dec-92	FALSE			34
SW-17	1000390	SD	01-Sep-92	FALSE	FIELD DUPLICATE	DUP OF 1000360	34
SW-17	1000391	SD	02-Dec-92	FALSE	FIELD DUPLICATE	DUP OF 1000361	34
SW-01	1000328	SD	31-Aug-92	FALSE			35
SW-01	1000329	SD	30-Nov-92	FALSE			35
SW-02	1000330	SD	31-Aug-92	FALSE			35
SW-02	1000331	SD	30-Nov-92	FALSE			35
SW-03	1000332	SD	31-Aug-92	FALSE			35
SW-03	1000333	SD	30-Nov-92	FALSE			35
SW-29	1461044	SD	20-Apr-93	FALSE			35
SW-19	1000193	SD	02-Sep-92	FALSE			35
SW-19	1000364	SD	03-Dec-92	FALSE			35
SW-20	1000185	SD	01-Sep-92	FALSE			35
SW-20	1000365	SD	01-Dec-92	FALSE			35
SW-21	1000186	SD	01-Sep-92	FALSE			35
SW-21	1000366	SD	01-Dec-92	FALSE			35
SW-22	1000187	SD	01-Sep-92	FALSE			35
SW-22	1000367	SD	01-Dec-92	FALSE			35

TABLE A1-5							
SAMPLES USED IN THE HUMAN HEALTH RISK CHARACTERIZATION							
SEDIMENT							
Olin Corporation							
Wilmington, MA Facility							
LOCATION	SAMPLENUM	MATRIXTYPE	DATE_TAKEN	ISA_BLANK	QAQC_TYPE	COMMENT	HHEPC#
SW-18	1000362	SD	02-Sep-92	FALSE			35
SW-18	1000363	SD	02-Dec-92	FALSE			35

ATTACHMENT 2

ATTACHMENT 2

CHARACTERIZATION OF BACKGROUND CONDITIONS

This attachment presents the background characterization for the Olin Corporation's Wilmington, MA Facility. Background analyte concentrations in soil, surface water, sediment, and groundwater in the area of the site have been characterized. The background sampling locations are shown in Figure 4 for soil, surface water and sediment, and Figure 7 for groundwater. Statistical background summaries and supporting documentation for these media are presented in Tables A2-1 through A2-5. The following paragraphs describe the background sampling and analytical programs for the various media.

The MCP at 310 CMR 40.0835(4)(f) requires a characterization of background concentrations of oil and/or hazardous materials (OHM) at the disposal site. "Background" is defined at 310 CMR 40.0006 as those levels of OHM that would exist in the absence of the disposal site of concern that are: (a) ubiquitous and consistently present in the environment at and in the vicinity of the disposal site of concern; and (b) attributable to geologic or ecological conditions, atmospheric deposition of industrial process or engine emissions, fill materials containing wood or coal ash, releases to groundwater from a public water supply system, and/or petroleum residues that are incidental to the normal operation of motor vehicles.

Soil. Two background soil samples were collected by CRA on November 2, 1992. Samples BGS-01 (surface soil) and BH-41 (subsurface soil) were analyzed for polycyclic aromatic hydrocarbons (PAHs) and metals. Five additional soil background samples (plus one duplicate) were collected by ABB-ES on April 22, 1996. Samples SS015XXBKX, SS016XXBKX, SS017XXBKX, SS017XXBKD (duplicate), SS018XXBKX and SS019XXBKX were analyzed for PAHs, calcium, potassium, sodium, sulfate, and nitrogen-ammonia as N. Detections in the CRA and ABB-ES samples are considered to be representative of background concentrations. Soil background concentrations for other organic compounds are assumed to be non-detectable and the background concentrations for the remaining inorganic parameters are assumed to be equal to the background concentrations presented in Table 2.1 of the Guidance for Disposal Site Risk Characterization (MADEP, 1995a). The analytical results and summary statistics for the seven background soil samples are presented in Table A2-1. In that table, median and maximum concentrations are presented for the analytes for which site-specific background data were collected. The concentrations reported by the MADEP (90th percentile values) are also presented.

Surface Water and Sediment. The MADEP indicates in its Guidance for Disposal Site Risk Characterization, Section 9, that it may not be possible to find background conditions in all aquatic environments due to the presence of contaminants from other disposal sites, permitted discharges, and many non-point sources. The MADEP guidance suggests that in an environmental risk characterization, it is appropriate to identify site-related contaminants in aquatic environments by comparing site conditions to "local conditions," which may not meet the MCP definition of background. Local conditions "are levels of OHM present consistently and uniformly throughout the surface water body, or throughout a larger section of river that contains the area potentially affected by contamination at or from the site." The background surface water and sediment sampling program conducted for this site demonstrated that conditions around the Wilmington facility that strictly meet the MCP definition of background may be difficult to identify; therefore, it is logical to apply the "local condition" concept to surface water and sediment.

Two background surface water samples and one background sediment sample were collected by CRA in November, 1992. These samples were collected at sampling locations SW-29 and SW-30. In a March 22, 1995 letter (MADEP, 1995b), the MADEP indicated that the surface water and sediment samples collected at locations SW-29 and SW-30 did not meet the MCP definition of background because it appears the locations of the background samples are being impacted by an "upstream" release. Consequently, these two samples are no longer considered "background" samples, although they may represent local conditions with respect to environmental receptors in the East Ditch area.

ABB-ES collected 14 surface water samples and 14 sediment background samples between April 1 and April 4, 1996, plus an additional sediment sample in May 1996. Five surface water samples

(SW001XXBKX through SW004XXBKX and SW014XXBKX and its duplicate (SW014XXBKD)) and five sediment samples (SD001XXBKX through SD004XXBKX and SD014XXBKX and its duplicate (SD014XXBKD)) were analyzed for inorganics (method 6010), total solids (sediment only), total organic carbon (sediment only), SVOCs (method 8270B), VOCs and trimethylpentenes (method 8240), and TCL pesticides (method 8080). Four surface water samples (SW001XXBKX through SW004XXBKX) were analyzed for chloride, hardness (as $CaCO_3$), total filterable solids, and sulfate. Surface water samples SW005XXBKX through SW013XXBKX and sediment samples SD001XXBKR and SD005XXBKX through SD013XXBKX were analyzed for TCL pesticides (method 8080). The analytical results for the background surface water and sediment samples are presented in Tables A2-2 and A2-3, respectively. In those tables, median and maximum concentrations are presented for the analytes for which site-specific background data were collected.

No pesticides or SVOCs were detected in any of the surface water background samples. Those inorganics and metals detected in at least one background surface water sample include aluminum, barium, calcium, chloride, iron, magnesium, manganese, potassium, sodium, sulfate, and zinc. Four VOCs (1,1,1-trichloroethane, tetrachloroethene, toluene, and xylene) were detected. 1,1,1-Trichloroethane (4 μg/liter) and tetrachloroethene (4 μg/liter) were detected in SW004XXBKX, while toluene (13 μg/liter) and xylene (19 μg/liter) were detected in SW001XXBKX. A comparison to VOC concentrations in associated blank samples indicates these isolated detections are not laboratory artifacts. These isolated detections of VOCs are unexpected, but these locations are still representative of background conditions for inorganics and metals, as shown by consistency with concentrations at other background surface water sampling locations. The isolated detections of VOCs are consistent with neither the MCP definition of background nor the concept of local conditions (i.e., present consistently and uniformly). Background levels of VOCs in surface water are therefore assumed to be non-detect, despite the isolated detections.

Nineteen metals, six pesticides, six SVOCs, and six VOCs were detected in at least one sediment background sample. The pesticides that were detected (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-chlordane, gamma-chlordane, and dieldrin) are persistent compounds that are routinely detected in sediments that are not impacted by direct sources of OHM (particularly in depositional areas). These compounds and their reported concentrations are considered background conditions. Among the SVOCs detected, bis(2-ethylhexyl)phthalate was found in three of five samples tested. This compound is detected almost ubiquitously in the environment and is also a common laboratory artifact. However, a comparison to associated blanks does not confirm that these detections are laboratory artifacts. Thus, detected concentrations of bis(2-ethylhexyl)phthalate are considered a background condition.

In three sediment background samples tested (including one duplicate), no PAHs were detected. Five PAHs were detected in SD001XXBKX and four PAHs (all estimated values below the reporting limit) were detected in SD002XXBKX. Concentrations of PAHs in SD001XXBKX appear to be substantially higher than concentrations in the only other sample with detected PAHs. This suggests this sampling location is impacted by some source and therefore is not representative of background conditions for SVOCs. Therefore, the PAH results for SD001XXBKX were not included in the background data set. PAH concentrations in background sediments are considered to be below the reporting limits for the background samples.

Among the VOCs detected in background sediment samples, 1,1,1-trichloroethane, acetone, methylene chloride, and xylene were each detected in two of five samples. Tetrachloroethene was detected in four of five samples, and 2-butanone was detected in one of five samples. These compounds are often laboratory artifacts; however, a comparison of detected concentrations to those in associated blanks does not suggest these VOC detections are laboratory artifacts. The isolated detections of VOCs are consistent with neither the MCP definition of background nor the concept of local conditions (i.e., present consistently and uniformly). Background levels of VOCs in sediment are therefore assumed to be non-detect, despite the isolated detections.

Groundwater. Groundwater monitoring wells were not installed specifically to collect background water quality data. In this evaluation, it is assumed, consistent with the MCP definition of background, that organic compounds (acid extractables, base neutral extractables, and volatiles) would not be detected in groundwater as a background condition. These compounds would not be present unless the groundwater was impacted by a release of OHM. The characterization of background conditions for groundwater is therefore focused on inorganics and metals.

ABB-ES has examined the levels of inorganics in raw water from the Town of Wilmington municipal supply wells, as well as inorganics in raw water from the Town of Reading municipal supply wells, from monitoring wells at various disposal sites in the area of the site, from several monitoring wells installed and monitored as part of the site investigation that historically have not shown evidence of site-related inorganic or metals contamination, and from numerous private drinking water wells that have not shown evidence of site-related inorganic or metals contamination. Based upon a review and evaluation of the available data, it appears that there are three major sources of background inorganics and metals data for groundwater. These sources are 1) monitoring wells installed during the site investigation that do not appear to be impacted with respect to inorganics and metals, 2) the Town of Wilmington Town Park water supply wells, and 3) numerous shallow private water supply wells located along Main Street to the West of the facility. A review and evaluation of analytical data from all of these sources reveals consistent water quality with many inorganics and metals either not detected or present at low concentrations. The three sources of background data are described further below.

Three monitoring well locations have been selected as part of the background data set. These locations include shallow and deep wells at GW-48-S and GW-48-D (approximately 150 feet east of the facility across the railroad tracks), a deep well at GW-72-D (approximately 900 feet southwest of the facility), and shallow and deep wells at GW-73-S and GW-73-D (approximately 2500 feet north-northwest of the facility and adjacent to the Town Park Pumping Station and Well). The locations of these wells are shown on Figure 7.

The raw water from the Town of Wilmington Town Park water supply well (located approximately 2600 feet north-northwest of the facility) is considered representative of background conditions for inorganics and metals. Multiple rounds of samples have been collected from the Town Park wells and included in the background data set. The locations of these supply wells are shown on Figure 7.

Fifteen private well locations located along Main Street (approximately 1000 to 1200 feet west of the facility) are also included in the groundwater background data set. Although these wells are located downgradient of the facility, concentrations of inorganics and metals in these wells are very low, and the quality of the water in these wells is consistent with the other background sampling locations. This indicates that the shallow groundwater along Main Street has not been impacted by site-related OHM. These locations include: M-24/L-116, M-24/L-117, M-24/L-54, M-24/L-63, M-24/L-64, M-24/L-65, M-24/L-66, M-24/L-72A, M-24/L-87A, M-24/L-94, M-25/L-03, M-25/L-04, M-25/L-06, M-25/L-07, and M-25/L-08-IN. The locations of these wells are shown on Figure 7.

All available analytical data for the background sampling locations from each of these three sources have been used to characterize background conditions. Analytical results for 82 unfiltered samples (plus four duplicates) collected between 1986 and 1996 are included in the data set. Table A2-4 presents the analytical results and summary statistics for the 82 samples. Table A2-5 presents all sample locations and sample numbers contained in this data set. In Table A2-4, minimum, maximum, and median concentrations in the database are reported for the VOCs, SVOCs, metals, and inorganics. In all cases, the reporting limit is the concentration considered representative of non-detects.

As can be seen in Table A2-4, the background condition for several analytes in unfiltered groundwater is "not detected." Detection limits are generally below concentrations that might be of human health concern. Analytes not detected at all in background samples include antimony, arsenic, beryllium, cadmium, chromium, cobalt, cyanide, fluoride, hexavalent chromium, mercury, nickel, selenium, silver, thallium, trivalent chromium, and vanadium. Those analytes that were detected in the groundwater background data set include aluminum (only 1 hit - Town Park 03Sep1992 0.14 mg/l), ammonia, barium, calcium, chloride, copper, iron, lead, magnesium, manganese, nitrate, nitrite, potassium, sodium, sulfate, and zinc. All sample results (not only detects) were included in the calculation of the summary statistics presented in Table A2-4.

TABLE A2-1
SOIL BACKGROUND ANALYTICAL RESULTS

Olin Corporation
Wilmington, MA Facility

Analyte	SS015XXBKX WM0747-2 4/22/96	SS016XXBKX WM0747-3 4/22/96	SS017XXBKD WM0747-4 (duplicate) 4/22/96	SS017XXBKX WM0747-1 4/22/96	SS018XXBKX WM0747-6 4/22/96	SS019XXBKX WM0747-7 4/22/96	BGS-01 11/02/92	BH-41 11/02/92
SVOC (ug/Kg)								
Benzo(b)fluoranthene	J 62	< 430	J 58	< 400	< 400	< 360	< 330	< 330
Fluoranthene	J 66	< 430	J 47	< 400	< 400	< 360	< 330	< 330
Phenanthrene	J 43	< 430	< 400	< 400	< 400	< 360	< 330	< 330
Pyrene	J 65	< 430	J 47	< 400	< 400	< 360	< 330	< 330
Metals (mg/Kg)								
Aluminum							7900	6100
Antimony							< 20	< 20
Arsenic							7.1	6.2
Barium							22	11
Beryllium							< 1.5	< 1.5
Cadmium							< 1	< 1
Calcium	2000	270	130	120	250	880	1400	620
Chromium							16	14
Cobalt							3.7	2.4
Copper							6.4	5.1
Iron							12000	9200
Lead							11	< 10
Magnesium							3000	2400
Manganese							150	100
Mercury							< 0.1	< 0.1
Nickel							6.5	5.5
Potassium	290	220	120	120	230	260	1400	910
Selenium							< 0.64	< 0.64
Silver							< 1.5	< 1.5
Sodium	35	29	22	23	26	28	130	39
Thallium							< 0.5	< 0.5
Vanadium							16	12

TABLE A2-1
SOIL BACKGROUND ANALYTICAL RESULTS

Olin Corporation
Wilmington, MA Facility

Analyte	SS015XXBKX WM0747-2 4/22/96	SS016XXBKX WM0747-3 4/22/96	SS017XXBKD WM0747-4 (duplicate) 4/22/96	SS017XXBKX WM0747-1 4/22/96	SS018XXBKX WM0747-6 4/22/96	SS019XXBKX WM0747-7 4/22/96	BGS-01 11/02/92	BH-41 11/02/92
Zinc							21	16
Wet Chemistry (mg/Kg)								
Nitrogen-Ammonia as N	< 8	37	17	34	31	19		
Sulfate	< 80	< 40	30	< 40	< 20	< 40		

TABLE A2-2
SURFACE WATER CONCENTRATIONS AT BACKGROUND SAMPLE LOCATIONS - SUMMARY STATISTICS

Olin Corporation
Wilmington, MA Facility

Analyte	Frequency of Detection*	Minimum SQL	Maximum SQL	Minimum Detected Concentration	Maximum Detected Concentration	Median of all Samples **
VOC (ug/L)						
1,1,1-Trichloroethane	1 / 5	5	5	4	4	<5
Tetrachloroethene	1 / 5	5	5	4	4	<5
Toluene	1 / 5	5	5	13	13	<5
Xylene	1 / 5	5	5	19	19	<5
Metals (mg/L)						
Aluminum	1 / 5	0.1	0.1	0.37	0.37	<0.1
Barium	5 / 5			0.01	0.034	0.018
Calcium	5 / 5			9.9	28	18
Iron	5 / 5			0.16	1.8	0.235
Magnesium	5 / 5			2.1	3.4	2.7
Manganese	5 / 5			0.01	0.1	0.042
Potassium	5 / 5			1.2	3.3	2.4
Sodium	5 / 5			32	58	44
Zinc	2 / 5	0.025	0.025	0.031	0.048	<0.025
Wet Chemistry (mg/L)						
Chloride	4 / 4			68	110	71
Hardness, CaCO3	4 / 4			35	87	56
Solids - Filterable	4 / 4			150	280	180
Sulfate	4 / 4			19	24	21

Duplicate samples were averaged with their original samples prior to calculation of statistics.
* Nine additional surface water samples (SW005XXBKX through SW013XXBKX) were collected and analyzed for pesticides only; however, no pesticides were detected in these background samples.
** The median represents the median value of all sample results, including non-detects, for which the reporting limit was used as the concentration value.
SQL = sample quantitation limit
ug/L = micrograms per liter
mg/L = milligrams per liter

TABLE A2-2
SURFACE WATER BACKGROUND ANALYTICAL RESULTS

Olin Corporation
Wilmington, MA Facility

Analyte	SW001XXBKX WM0593-1 4/1/96	SW002XXBKX WM0593-4 4/1/96	SW003XXBKX WM0625-5 4/3/96	SW004XXBKX WM0625-6 4/3/96	SW014XXBKD WM0640-8 (duplicate) 4/4/96	SW014XXBKX WM0640-7 4/4/96
VOC (ug/L)						
1,1,1-Trichloroethane	< 5	< 5	< 5	J 4	< 5	< 5
Tetrachloroethene	< 5	< 5	< 5	J 4	< 5	< 5
Toluene	13	< 5	< 5	< 5	< 5	< 5
Xylene	19	< 5	< 5	< 5	< 5	< 5
Metals (mg/L)						
Aluminum	< 0.1	0.37	< 0.1	< 0.1	< 0.1	< 0.1
Barium	0.034	0.023	0.01	0.018	0.019	0.018
Calcium	28	18	9.9	15	19	18
Iron	1.8	0.56	0.18	0.16	0.25	0.22
Magnesium	3.4	3	2.1	2.7	2.7	2.6
Manganese	0.099	0.1	0.01	0.01	0.042	0.041
Potassium	3.3	2.4	1.2	2.6	2.1	2
Sodium	58	32	37	44	47	45
Zinc	0.048	< 0.025	< 0.025	< 0.025	0.032	0.03
Wet Chemistry (mg/L)						
Chloride	110	68	74	81		
Hardness, CaCO3	87	62	35	50		
Solids - Filterable Residue	280	190	150	170		
Sulfate	24	22	19	20		

TABLE A2-3
SEDIMENT CONCENTRATIONS AT BACKGROUND SAMPLE LOCATIONS - SUMMARY STATISTICS

Olin Corporation
Wilmington, MA Facility

Analyte	Frequency of Detection	Range of SQLs	Minimum Detected Concentration	Maximum Detected Concentration	Median of all Samples*
VOCs (ug/Kg)					
1,1,1-Trichloroethane	2/5	9 - 15	8.8	19	<14
2-Butanone	1/5	27 - 44	130	130	<42
Acetone	2/5	27 - 44	11	190	<42
Methylene Chloride	2/5	23 - 29	12	13	<23
Tetrachloroethene	4/5	12 - 12	6	25	12
Xylene	2/5	12 - 29	4	9	<12
SVOCs (ug/Kg)					
Benzo(a)Pyrene	1/4	530 - 960	420	420	<668
Benzo(b)fluoranthene	1/4	530 - 790	750	750	572
Chrysene	1/4	530 - 790	510	510	<960
Fluoranthene	1/4	530 - 790	860	860	<668
Pyrene	1/4	530 - 790	750	750	<668
bis(2-ethylhexyl)phthalate	3/5	760 - 960	315	2,000	572
Pesticides (ug/Kg)					
4,4'-DDD	10/14	5 - 9.6	2.8	260	7.6
4,4'-DDE	8/14	5 - 9.6	2.8	460	<8.5
4,4'-DDT	3/14	5 - 12	8.1	31	8.5
Alpha-chlordane	1/14	2.6 - 9.5	5.6	5.6	<4.4
Dieldrin	2/14	2.9 - 18	17	27	<9.2
Gamma-chlordane	1/14	2.6 - 9.5	5.3	5.3	<4.4
Metals (mg/Kg)					
Aluminum	5/5	NR	1,100	12,000	6,300
Arsenic	5/5	NR	6.9	44	8.5
Barium	5/5	NR	8.2	45	32.5
Calcium	5/5	NR	1,300	4,100	2,100
Chromium (VI)	4/5	0.5 - 0.5	0.53	1.2	0.53
Chromium, Total	5/5	NR	11	19.5	13
Cobalt	2/5	4.9 - 7.2	5.1	6.7	6.7
Copper	4/5	5.7 - 5.7	15	33	21
Iron	5/5	NR	4,000	14,000	6,400
Lead	5/5	NR	11	89	26.5
Magnesium	5/5	NR	220	3,200	1,200
Manganese	5/5	NR	55	680	128
Mercury	3/5	0.14 - 0.27	0.27	0.54	0.27

TABLE A2-3
SEDIMENT CONCENTRATIONS AT BACKGROUND SAMPLE LOCATIONS - SUMMARY STATISTICS

Olin Corporation
Wilmington, MA Facility

Analyte	Frequency of Detection	Range of SQLs	Minimum Detected Concentration	Maximum Detected Concentration	Median of all Samples*
Nickel	2/5	7.8 - 9.6	11	15.5	<9.6
Potassium	4/5	100 - 100	270	805	490
Sodium	5/5	NR	70	290	114
Thallium	1/5	2.5 - 3.8	3.6	3.6	<3.4
Vanadium	5/5	NR	8.9	26	16
Zinc	5/5	NR	18	130	61.5
Other (mg/Kg)					
Solids-Total Residue (TS) (wt%)	15/15	NR	18	69	39
Total Organic Carbon	11/11	NA	15,000	380,000	66,000

Duplicate samples were averaged with their original samples prior to calculation of statistics.
PAH data for SD001XXBKX were not included in summary statistics
* The median represents the median value of all sample results, including non-detects, for which the reporting limit was used as the concentration value.
SQL = sample quantitation limit
ug/L = micrograms per liter
mg/L = milligrams per liter

TABLE A2-3
SEDIMENT BACKGROUND ANALYTICAL RESULTS

Olin Corporation
Wilmington, MA Facility

Analyte	SD001XXBKR WM0992-1 5/21/96	SD001XXBKX WM0593-2 4/1/96	SD002XXBKX WM0593-5 4/1/96	SD003XXBKX WM0625-7 4/3/96	SD004XXBKX WM0625-8 4/3/96	SD005XXBKX WM0607-2 4/2/96	SD006XXBKX WM0607-3 4/2/96	SD007XXBKX WM0607-4 4/2/96
VOCs (ug/Kg)								
1,1,1-Trichloroethane		19	< 15	< 14	< 12			
2-Butanone		< 35	< 44	< 42	130			
Acetone		JB 11	< 44	< 42	B 190			
Methylene Chloride		< 23	< 29	J 13	< 24			
Tetrachloroethene		25	J 12	J 6	< 12			
Xylene		< 12	J 9	< 14	< 12			
SVOCs (ug/Kg)								
Benzo(a)Pyrene		1800	< 960	< 790	J 420			
Benzo(b)fluoranthene		4100	J 750	< 790	< 790			
Chrysene		2900	J 510	< 790	< 790			
Fluoranthene		4800	J 860	< 790	< 790			
Pyrene		3600	J 750	< 790	< 790			
bis(2-ethylhexyl)phthalate		< 760	< 960	1600	2000			
Pesticides (ug/Kg)								
4,4'-DDD	< 5.6		17	22	J 4.6	< 5	150	7.4
4,4'-DDE	< 5.6		15	17	< 7.9	< 5	47	J 4.4
4,4'-DDT	< 5.6		J 8.1	< 9.2	< 7.9	< 5	< 12	
Alpha-chlordane	< 2.9		5.6	< 4.8	< 4.1	< 2.6	< 6.1	< 3.1
Dieldrin	< 2.9		< 9.6	< 9.2	< 7.9	< 5	< 12	< 5.9
Gamma-chlordane	< 2.9		5.3	< 4.8	< 4.1	< 2.6	< 6.1	< 3.1
Metals (mg/Kg)								
Aluminum		4300	12000	6300	1100			
Arsenic		9.7	8.5	6.9	44			
Barium		16	39	45	8.2			
Calcium		1300	2100	4100	2400			
Chromium (VI)		< .5	.53	.53	1.2			
Chromium, Total		12	16	13	11			
Cobalt		< 5.8	< 7.2	6.7	< 6.8			
Copper		33	21	15	< 5.7			
Iron		5900	14000	6400	4000			
Lead		20	58	89	11			
Magnesium		1200	1000	1700	220			
Manganese		55	680	630	77			
Mercury		.54	.33	.27	< .2			

TABLE A2-3
SEDIMENT BACKGROUND ANALYTICAL RESULTS

Olin Corporation
Wilmington, MA Facility

Analyte	SD001XXBKR WM0992-1 5/21/96	SD001XXBKX WM0593-2 4/1/96	SD002XXBKX WM0593-5 4/1/96	SD003XXBKX WM0625-7 4/3/96	SD004XXBKX WM0625-8 4/3/96	SD005XXBKX WM0607-2 4/2/96	SD006XXBKX WM0607-3 4/2/96	SD007XXBKX WM0607-4 4/2/96
Nickel		< 7.8	< 9.6	11	< 9.1			
Potassium		510	270	490	< 100			
Sodium		110	180	290	70			
Thallium		< 2.9	3.6	< 3.8	< 3.4			
Vanadium		16	15	21	8.9			
Zinc		66	130	59	18			
Other (mg/Kg)								
Solids-Total Residue (TS) %	59	44	35	36	41	68	28	55
Total Organic Carbon	17000	34000	59000	130000	380000	21000	110000	66000

TABLE A2-3
SEDIMENT BACKGROUND ANALYTICAL RESULTS

Olin Corporation
Wilmington, MA Facility

Analyte	SD008XXBKX WM0625-3 4/3/96	SD009XXBKX WM0625-4 4/3/96	SD010XXBKX WM0640-4 4/4/96	SD011XXBKX WM0640-5 4/4/96	SD012XXBKX WM0640-6 4/4/96	SD013XXBKX WM0607-1 4/2/96	SD014XXBKD WM0640-11 (duplicate) 4/4/96	SD014XXBKX WM0640-10 4/4/96
VOCs (ug/Kg)								
1,1,1-Trichloroethane							< 9	J 13
2-Butanone							< 27	< 44
Acetone							< 27	< 44
Methylene Chloride							JB 10	< 29
Tetrachloroethene							14	22
Xylene							J 4	< 15
SVOCs (ug/Kg)								
Benzo(a)Pyrene							< 560	< 530
Benzo(b)fluoranthene							< 560	< 530
Chrysene							< 560	< 530
Fluoranthene							< 560	< 530
Pyrene							< 560	< 530
bis(2-ethylhexyl)phthalate							J 390	J 240
Pesticides (ug/Kg)								
4,4'-DDD	J 2.8	14	J 5.4	< 6.6	21	260	< 5.9	< 9.6
4,4'-DDE	J 2.8	21	< 9.2	< 6.6	J 6.1	460	< 5.9	< 9.6
4,4'-DDT	< 5	< 8.9	< 9.2	< 6.6	< 11	31	< 5.9	< 9.6
Alpha-chlordane	< 2.6	< 4.6	< 4.8	< 3.4	< 5.6	< 9.5	< 3.1	< 4.9
Dieldrin	27	17	< 9.2	< 6.6	< 11	< 18	< 5.9	< 9.6
Gamma-chlordane	< 2.6	< 4.6	< 4.8	< 3.4	< 5.6	< 9.5	< 3.1	< 4.9
Metals (mg/Kg)								
Aluminum							8500	14000
Arsenic							4.8	9.2
Barium							25	40
Calcium							1000	1600
Chromium (VI)							.66	.74
Chromium, Total							15	24
Cobalt							< 4.9	7.8
Copper							17	29
Iron							6800	11000
Lead							20	33
Magnesium							2400	3900
Manganese							97	160
Mercury							< .14	< .27

TABLE A2-3
SEDIMENT BACKGROUND ANALYTICAL RESULTS

Olin Corporation
Wilmington, MA Facility

Analyte	SD008XXBKX WM0625-3 4/3/96	SD009XXBKX WM0625-4 4/3/96	SD010XXBKX WM0640-4 4/4/96	SD011XXBKX WM0640-5 4/4/96	SD012XXBKX WM0640-6 4/4/96	SD013XXBKX WM0607-1 4/2/96	SD014XXBKD WM0640-11 (duplicate) 4/4/96	SD014XXBKX WM0640-10 4/4/96
Nickel							12	19
Potassium							630	980
Sodium							89	140
Thallium							< 2.5	< 3.7
Vanadium							19	32
Zinc							45	78
Other (mg/Kg)								
Solids-Total Residue (TS) %	69	37	36	51	31	18	57	34
Total Organic Carbon	15000	140000				260000		

TABLE A2-4
GROUNDWATER BACKGROUND ANALYTICAL RESULTS

Olin Corporation
Wilmington, MA Facility

Analyte	1000032	1000033	1000157	1000158	1000286	1000287	1000291	1000392
VOCs (ug/L)								
1,3,5-Trimethylbenzene								
Acetone			12	8	< 15	< 15	< 15	< 15
Chlorobenzene			1	< 5	< 5	< 5	< 5	< 5
Chloroform			< 5	1	< 5	< 5	4	< 5
cis-1,2-Dichloroethene								
Methylene Chloride			< 10	< 10	< 10	< 10	< 10	< 10
Tetrachloroethene (PCE)			< 5	< 5	< 5	< 5	< 5	< 5
Toluene			< 5	< 5	< 5	< 5	< 5	< 5
Trichloroethene (TCE)			< 5	< 5	5	< 5	< 5	< 5
SVOCs (ug/L)								
1,2-Dichlorobenzene			< 10	< 10	< 10	< 10	< 10	< 10
Naphthalene			< 10	< 10	< 10	< 10	< 10	< 10
Metals (mg/L)								
Aluminum								
Barium								
Calcium								
Copper								
Iron								
Lead								
Magnesium								
Manganese								
Potassium								
Sodium								
Zinc								
Inorganics (mg/L)								
Chloride	31	9.2	28	11	45	8.3	18	
Nitrate as N								

TABLE A2-4
GROUNDWATER BACKGROUND ANALYTICAL RESULTS

Olin Corporation
Wilmington, MA Facility

Analyte	1000032	1000033	1000157	1000158	1000286	1000287	1000291	1000392
Nitrite as N								
Nitrogen, Ammonia	< 0.1	0.27	0.13		0.14	0.1	< 0.1	
Sulfate as SO4	16	32	13	32	20	29	29	
Total Dissolved Solids (TDS)								

TABLE A2-4
GROUNDWATER BACKGROUND ANALYTICAL RESULTS

Olin Corporation
Wilmington, MA Facility

Analyte	1000393	1000431	1000432	1000433	1000434	1000435	1000436	1000438
VOCs (ug/L)								
1,3,5-Trimethylbenzene								
Acetone	< 15							
Chlorobenzene	< 5							
Chloroform	< 5							
cis-1,2-Dichloroethene								
Methylene Chloride	< 10							
Tetrachloroethene (PCE)	< 5							
Toluene	< 5							
Trichloroethene (TCE)	< 5							
SVOCs (ug/L)								
1,2-Dichlorobenzene								
Naphthalene	< 10							
Metals (mg/L)								
Aluminum								
Barium								
Calcium		24	24	21	32	23		
Copper		0.01	< 0.03	< 0.03	0.13	0.03		
Iron		1.4	2.3	1.1	6.6	3.5		
Lead					0.009			
Magnesium		4.2	4.2	3.5	4.4	4		
Manganese		0.42	0.47	0.45	0.42	0.57		
Potassium		2	3.1	3.2	2.8	2.9		
Sodium		37	50	55	54	35		
Zinc								
Inorganics (mg/L)								
Chloride	3.7	67	76	85	105	65	75	100
Nitrate as N		0.6	0.5	0.7	0.5	0.42		

TABLE A2-4
GROUNDWATER BACKGROUND ANALYTICAL RESULTS

Olin Corporation
Wilmington, MA Facility

Analyte	1000393	1000431	1000432	1000433	1000434	1000435	1000436	1000438
Nitrite as N		< 0.002	0.005		0.008	0.012		
Nitrogen, Ammonia	< 0.1	0.22	0.26	0.18	0.08	0.3	0.22	0.25
Sulfate as SO4	9.7	40	40	30	27	29	31	27
Total Dissolved Solids (TDS)								

TABLE A2-4
GROUNDWATER BACKGROUND ANALYTICAL RESULTS

Olin Corporation
Wilmington, MA Facility

Analyte	1000439	1000440	1460003	1460430	1460486	1460704	1460709	1460714
VOCs (ug/L)								
1,3,5-Trimethylbenzene								
Acetone								
Chlorobenzene			< 0.2					
Chloroform			< 0.26					
cis-1,2-Dichloroethene			2					
Methylene Chloride			1.7					
Tetrachloroethene (PCE)			0.16					
Toluene								
Trichloroethene (TCE)			2.7					
SVOCs (ug/L)								
1,2-Dichlorobenzene								
Naphthalene			0.26					
Metals (mg/L)								
Aluminum			0.14					
Barium			0.026					
Calcium	27	18		25	29	29	33	25
Copper			< 0.025					
Iron			4					
Lead			< 0.005					
Magnesium	4.7	2.8		4.4	5.1	4.9	4.9	4.2
Manganese			0.48					
Potassium								
Sodium	50	49	40	70	60	69	73	76
Zinc			< 0.025					
Inorganics (mg/L)								
Chloride	110	78	72	130	88	110	150	140
Nitrate as N		1.2	0.53	0.78	0.56	0.68	0.49	0.97

TABLE A2-4
GROUNDWATER BACKGROUND ANALYTICAL RESULTS

Olin Corporation
Wilmington, MA Facility

Analyte	1000439	1000440	1460003	1460430	1460486	1460704	1460709	1460714
Nitrite as N			< 0.05					
Nitrogen, Ammonia	0.33	< 0.1	0.34	0.2	0.25	0.23	0.3	0.16
Sulfate as SO4	31	18	27	18	38	20	31	18
Total Dissolved Solids (TDS)								

TABLE A2-4
GROUNDWATER BACKGROUND ANALYTICAL RESULTS

Olin Corporation
Wilmington, MA Facility

Analyte	1460732	1460756	1460757 Duplicate	1460758	1460759	1460760	1460762	1460764
VOCs (ug/L)								
1,3,5-Trimethylbenzene		0.02	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	
Acetone								
Chlorobenzene		< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	
Chloroform		< 0.16	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16	
cis-1,2-Dichloroethene								
Methylene Chloride		1.2	0.87	0.44	0.71	0.48	0.55	
Tetrachloroethene (PCE)		< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	
Toluene		< 0.13	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13	
Trichloroethene (TCE)		< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	
SVOCs (ug/L)								
1,2-Dichlorobenzene		44	42	84	72	77	60	
Naphthalene		0.05	0.05	< 10	< 10	< 10	< 10	
Metals (mg/L)								
Aluminum		< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	
Barium		< 0.005	< 0.005	0.022	0.007	0.006	< 0.005	
Calcium	32							
Copper		0.039	0.036	0.04	0.032	< 0.025	0.042	
Iron		1.2	1.2	0.48	0.64	0.43	0.52	
Lead		< 0.005	< 0.005	< 0.005	< 0.005	0.005	< 0.005	
Magnesium	5.5							
Manganese		0.72	0.72	0.97	0.16	0.38	0.19	
Potassium								
Sodium	72	17	17	20	31	21	20	
Zinc		< 0.025	< 0.025	< 0.025	0.14	< 0.025	< 0.025	
Inorganics (mg/L)								
Chloride	130	21	21	42	56	34	38	36
Nitrate as N	0.61	0.29	0.26	0.19	< 0.29	0.22	0.28	

TABLE A2-4
GROUNDWATER BACKGROUND ANALYTICAL RESULTS

Olin Corporation
Wilmington, MA Facility

Analyte	1460732	1460756	1460757 Duplicate	1460758	1460759	1460760	1460762	1460764
Nitrite as N								
Nitrogen, Ammonia	0.31	< 0.1	< 0.1	0.32	< 0.1	0.54	0.37	< 0.1
Sulfate as SO4	35	16	16	13	16	18	16	13
Total Dissolved Solids (TDS)		120	120	140	150	140	120	

TABLE A2-4
GROUNDWATER BACKGROUND ANALYTICAL RESULTS

Olin Corporation
Wilmington, MA Facility

Analyte	1460766	1460767	1460768	1460769	1460770	1460771	1460772	1460773
VOCs (ug/L)								
1,3,5-Trimethylbenzene								
Acetone								
Chlorobenzene								
Chloroform								
cis-1,2-Dichloroethene								
Methylene Chloride								
Tetrachloroethene (PCE)								
Toluene								
Trichloroethene (TCE)								
SVOCs (ug/L)								
1,2-Dichlorobenzene								
Naphthalene								
Metals (mg/L)								
Aluminum								
Barium								
Calcium								
Copper								
Iron								
Lead								
Magnesium								
Manganese								
Potassium								
Sodium								
Zinc								
Inorganics (mg/L)								
Chloride	20	86	98	75	40	58	99	56
Nitrate as N								

TABLE A2-4
GROUNDWATER BACKGROUND ANALYTICAL RESULTS

Olin Corporation
Wilmington, MA Facility

Analyte	1460766	1460767	1460768	1460769	1460770	1460771	1460772	1460773
Nitrite as N								
Nitrogen, Ammonia	< 0.1	< 0.1	< 0.1	< 0.1	0.44	< 0.1	< 0.1	< 0.1
Sulfate as SO4	13	18	16	17	20	18	20	23
Total Dissolved Solids (TDS)								

TABLE A2-4
GROUNDWATER BACKGROUND ANALYTICAL RESULTS

Olin Corporation
Wilmington, MA Facility

Analyte	1460774	1460775	1460776	1460777	1460778	1460779	1460780	1460781
VOCs (ug/L)								
1,3,5-Trimethylbenzene								
Acetone								
Chlorobenzene								
Chloroform								
cis-1,2-Dichloroethene								
Methylene Chloride								
Tetrachloroethene (PCE)								
Toluene								
Trichloroethene (TCE)								
SVOCs (ug/L)								
1,2-Dichlorobenzene								
Naphthalene								
Metals (mg/L)								
Aluminum								
Barium								
Calcium								
Copper								
Iron								
Lead								
Magnesium								
Manganese								
Potassium								
Sodium								
Zinc								
Inorganics (mg/L)								
Chloride	92	5.3	66	91	51	48	17	67
Nitrate as N								

TABLE A2-4
GROUNDWATER BACKGROUND ANALYTICAL RESULTS

Olin Corporation
Wilmington, MA Facility

Analyte	1460774	1460775	1460776	1460777	1460778	1460779	1460780	1460781
Nitrite as N								
Nitrogen, Ammonia	< 0.1	< 0.1	< 0.1	< 0.1	0.42	< 0.1	< 0.1	< 0.1
Sulfate as SO4	17		34	31	14	18	16	15
Total Dissolved Solids (TDS)								

TABLE A2-4
GROUNDWATER BACKGROUND ANALYTICAL RESULTS

Olin Corporation
Wilmington, MA Facility

Analyte	1460782	1460783	1460784	1460785	1460786	1460787	1460788	1460791
VOCs (ug/L)								
1,3,5-Trimethylbenzene								< 0.07
Acetone								
Chlorobenzene								< 0.05
Chloroform								< 0.16
cis-1,2-Dichloroethene								< 0.22
Methylene Chloride								0.27
Tetrachloroethene (PCE)								< 0.04
Toluene								0.23
Trichloroethene (TCE)								< 0.1
SVOCs (ug/L)								
1,2-Dichlorobenzene								82
Naphthalene								< 10
Metals (mg/L)								
Aluminum								< 0.1
Barium								0.022
Calcium								
Copper								0.031
Iron								< 0.025
Lead								< 0.005
Magnesium								
Manganese								
Potassium								
Sodium								37
Zinc								< 0.025
Inorganics (mg/L)								
Chloride	120	73	82	33	5.2	39	88	92
Nitrate as N								6

TABLE A2-4
GROUNDWATER BACKGROUND ANALYTICAL RESULTS

Olin Corporation
Wilmington, MA Facility

Analyte	1460782	1460783	1460784	1460785	1460786	1460787	1460788	1460791
Nitrite as N								
Nitrogen, Ammonia	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.45	< 0.1	< 0.1
Sulfate as SO4	19	43	38	16	11	15	26	39
Total Dissolved Solids (TDS)								

TABLE A2-4
GROUNDWATER BACKGROUND ANALYTICAL RESULTS

Olin Corporation
Wilmington, MA Facility

Analyte	1460792	1460793	1460794	1460795	1460796	1460797	1460798	1460800 Duplicate
VOCs (ug/L)								
1,3,5-Trimethylbenzene	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
Acetone								
Chlorobenzene	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Chloroform	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16	< 0.16	0.53	< 0.16
cis-1,2-Dichloroethene	< 0.22	< 0.22	< 0.22	< 0.22	< 0.22	< 0.22	< 0.22	
Methylene Chloride	0.27	0.6	0.34	< 0.24	0.32	0.33	0.42	0.41
Tetrachloroethene (PCE)	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04	0.1	< 0.04
Toluene	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13	< 0.13
Trichloroethene (TCE)	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
SVOCs (ug/L)								
1,2-Dichlorobenzene	90	77	68	71	93	68	87	78
Naphthalene	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Metals (mg/L)								
Aluminum	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Barium	0.013	0.024	0.021	< 0.005	0.007	< 0.005	0.017	0.023
Calcium								
Copper	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	< 0.025	0.036	0.026
Iron	< 0.025	< 0.025	< 0.025	< 0.025	0.22	< 0.025	< 0.025	< 0.091
Lead	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Magnesium								
Manganese								
Potassium								
Sodium	9.1	8.7	12	18	28	26	4.8	37
Zinc	< 0.025	< 0.025	0.067	0.059	0.05	< 0.025	0.058	< 0.025
Inorganics (mg/L)								
Chloride	98	88	130	73	54	26	6.9	92
Nitrate as N	0.24	0.34	0.2	1.7	5.1	< 0.05	4.2	6.2

TABLE A2-4
GROUNDWATER BACKGROUND ANALYTICAL RESULTS

Olin Corporation
Wilmington, MA Facility

Analyte	1460792	1460793	1460794	1460795	1460796	1460797	1460798	1460800 Duplicate
Nitrite as N								
Nitrogen, Ammonia	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Sulfate as SO4	19	19	19	37	27	18	9.4	39
Total Dissolved Solids (TDS)								

TABLE A2-4
GROUNDWATER BACKGROUND ANALYTICAL RESULTS

Olin Corporation
Wilmington, MA Facility

Analyte	1460832	1460833	1460960	1460967	1460975	1461026	1461027	1461028
VOCs (ug/L)								
1,3,5-Trimethylbenzene								
Acetone								
Chlorobenzene								
Chloroform								
cis-1,2-Dichloroethene								
Methylene Chloride								
Tetrachloroethene (PCE)								
Toluene								
Trichloroethene (TCE)								
SVOCs (ug/L)								
1,2-Dichlorobenzene								
Naphthalene								
Metals (mg/L)								
Aluminum						< 0.2	< 0.2	< 0.2
Barium						< 0.1	< 0.1	< 0.1
Calcium			36	96	23.6	64.2	71.5	52.5
Copper						< 0.02	< 0.02	0.036
Iron						0.088	0.097	0.041
Lead						0.0063	< 0.005	< 0.005
Magnesium			5.8	5.4	4.26	10	5.89	5.6
Manganese						< 0.01	< 0.01	< 0.01
Potassium				3.3		2.6	1.48	2.62
Sodium			93	76	52.6	11.2	32.6	38.7
Zinc						< 0.02	< 0.02	0.03
Inorganics (mg/L)								
Chloride	96	180	70	164	90.8	72.1	103	107
Nitrate as N			0.29	2.3	< 0.2	0.24	0.97	3.25

TABLE A2-4
GROUNDWATER BACKGROUND ANALYTICAL RESULTS

Olin Corporation
Wilmington, MA Facility

Analyte	1460832	1460833	1460960	1460967	1460975	1461026	1461027	1461028
Nitrite as N						< 0.005	< 0.005	< 0.005
Nitrogen, Ammonia	< 0.1	< 0.1	0.49		< 5	< 0.5	< 0.5	< 0.5
Sulfate as SO4	20	19	55	49	32	13	30	21
Total Dissolved Solids (TDS)						316	338	328

TABLE A2-4
GROUNDWATER BACKGROUND ANALYTICAL RESULTS

Olin Corporation
Wilmington, MA Facility

Analyte	1461029	1461030	1461031	1461032 Duplicate	1461033	1461034	1461035	1461036
VOCs (ug/L)								
1,3,5-Trimethylbenzene								
Acetone								
Chlorobenzene								
Chloroform								
cis-1,2-Dichloroethene								
Methylene Chloride								
Tetrachloroethene (PCE)								
Toluene								
Trichloroethene (TCE)								
SVOCs (ug/L)								
1,2-Dichlorobenzene								
Naphthalene								
Metals (mg/L)								
Aluminum	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Barium	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Calcium	21.4	34.4	68.9	69.5	53.6	72.9	13.2	7.53
Copper	< 0.02	0.043	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.103
Iron	< 0.03	< 0.03	0.084	0.095	0.1	< 0.03	0.554	0.065
Lead	< 0.005	< 0.005	< 0.005	< 0.005	0.0056	< 0.005	< 0.005	< 0.005
Magnesium	1.43	4.98	9.78	9.8	7.08	8.16	1.99	1.28
Manganese	< 0.015	0.115	< 0.01	< 0.01	0.075	< 0.01	0.859	0.043
Potassium	2.62	2.87	2.17	2.51	1.87	2.64	1.64	1.65
Sodium	23.2	121	13.1	13.1	31.3	20.6	15.3	23.3
Zinc	< 0.02	< 0.02	0.178	0.182	< 0.02	< 0.02	< 0.02	0.098
Inorganics (mg/L)								
Chloride	33.2	235	104	104	78.7	80	19	32.2
Nitrate as N	3.25	0.88	0.45	0.46	0.51	2.57	0.48	0.44

TABLE A2-4
GROUNDWATER BACKGROUND ANALYTICAL RESULTS

Olin Corporation
Wilmington, MA Facility

Analyte	1461029	1461030	1461031	1461032 Duplicate	1461033	1461034	1461035	1461036
Nitrite as N	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Nitrogen, Ammonia	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Sulfate as SO4	21	21	18	19	30	27	18	22
Total Dissolved Solids (TDS)	168	463	342	347	316	319	143	88

TABLE A2-4
GROUNDWATER BACKGROUND ANALYTICAL RESULTS

Olin Corporation
Wilmington, MA Facility

Analyte	1461037 Duplicate	1461038	1461039	1461106	1461107	1461108
VOCs (ug/L)						
1,3,5-Trimethylbenzene						
Acetone						
Chlorobenzene						
Chloroform						
cis-1,2-Dichloroethene						
Methylene Chloride						
Tetrachloroethene (PCE)						
Toluene						
Trichloroethene (TCE)						
SVOCs (ug/L)						
1,2-Dichlorobenzene						
Naphthalene						
Metals (mg/L)						
Aluminum	< 0.2	< 0.2	< 0.2			
Barium	< 0.1	< 0.1	< 0.1			
Calcium	7.68	61.9	< 0.1			
Copper	0.104	< 0.02	0.133			
Iron	0.049	< 0.03	< 0.03			
Lead	< 0.005	< 0.005	< 0.005			
Magnesium	1.31	9.16	0.1			
Manganese	0.048	< 0.01	< 0.01			
Potassium	1.62	2.02	0.55			
Sodium	24.3	10.5	175			
Zinc	0.049	< 0.02	< 0.02			
Inorganics (mg/L)						
Chloride	34.1	88.2	229			
Nitrate as N	0.45	0.2	2.69			

TABLE A2-4
GROUNDWATER BACKGROUND ANALYTICAL RESULTS

Olin Corporation
Wilmington, MA Facility

Analyte	1461037 Duplicate	1461038	1461039	1461106	1461107	1461108
Nitrite as N	< 0.005	< 0.005	< 0.005			
Nitrogen, Ammonia	< 0.5	< 0.5	< 0.5			
Sulfate as SO4	18	18	21			
Total Dissolved Solids (TDS)	118	356	520			

TABLE A2-5
LIST OF SAMPLES FOR GROUNDWATER

Sample Number	Location	Date Collected
1000032	GW-48-D	01-Aug-91
1000033	GW-48-S	01-Aug-91
1000157	GW-48-D	12-Aug-92
1000158	GW-48-S	12-Aug-92
1000286	GW-48-D	17-Nov-92
1000287	GW-48-S	17-Nov-92
1000291	GW-72-D	17-Nov-92
1000392	GW-73-D	20-Apr-93
1000393	GW-73-S	20-Apr-93
1000431	TOWN PARK	11-Apr-86
1000432	TOWN PARK	24-Mar-87
1000433	TOWN PARK	25-Mar-88
1000434	TOWN PARK	13-Feb-89
1000435	TOWN PARK	30-May-90
1000436	TOWN PARK	22-Feb-92
1000438	TOWN PARK	20-Oct-93
1000439	TOWN PARK	15-Feb-94
1000440	TOWN PARK	10-May-94
1460003	TOWN PARK	03-Sep-92
1460430	TOWN PARK	31-May-95
1460486	TOWN PARK	27-Sep-95
1460704	TOWN PARK	24-Aug-94
1460709	TOWN PARK	15-Nov-94
1460714	TOWN PARK	08-Feb-95
1460732	TOWN PARK	27-Mar-96
1460756	M-25/L-07	16-Sep-91
1460757	M-25/L-07	16-Sep-91
1460758	M-25/L-03	16-Sep-91
1460759	M-25/L-04	16-Sep-91
1460760	M-25/L-08-IN	16-Sep-91
1460762	M-25/L-06	16-Sep-91
1460764	M-24/L-54	20-Jul-95
1460766	M-24/L-87A	20-Jul-95
1460767	M-24/L-63	20-Jul-95
1460768	M-24/L-64	20-Jul-95
1460769	M-24/L-94	20-Jul-95
1460770	M-25/L-08-IN	20-Jul-95
1460771	M-24/L-117	18-May-94
1460772	M-24/L-64	18-May-94
1460773	M-24/L-94	15-Feb-94
1460774	M-24/L-72A	15-Feb-94
1460775	M-24/L-87A	15-Feb-94
1460776	M-24/L-63	15-Feb-94
1460777	M-25/L-04	15-Feb-94
1460778	M-25/L-08-IN	15-Feb-94
1460779	M-24/L-72A	10-Mar-92
1460780	M-24/L-54	10-Mar-92
1460781	M-24/L-66	10-Mar-92
1460782	M-24/L-64	10-Mar-92
1460783	M-24/L-63	10-Mar-92
1460784	M-24/L-65	10-Mar-92

TABLE A2-5
LIST OF SAMPLES FOR GROUNDWATER

Sample Number	Location	Date Collected
1460785	M-24/L-117	10-Mar-92
1460786	M-24/L-87A	10-Mar-92
1460787	M-25/L-08-IN	10-Mar-92
1460788	M-24/L-94	10-Mar-92
1460791	M-24/L-63	15-Oct-90
1460792	M-24/L-72A	15-Oct-90
1460793	M-24/L-64	15-Oct-90
1460794	M-24/L-66	15-Oct-90
1460795	M-24/L-65	15-Oct-90
1460796	M-24/L-94	15-Oct-90
1460797	M-24/L-54	15-Oct-90
1460798	M-24/L-87A	15-Oct-90
1460800	M-24/L-63	15-Oct-90
1460832	M-24/L-72A	27-Jul-95
1460833	M-24/L-116	20-Jul-95
1460960	TOWN PARK	13-Dec-95
1460967	TOWN PARK	05-Dec-94
1460975	TOWN PARK	19-Jun-96
1461026	M-24/L-64	12-Aug-96
1461027	M-24/L-87A	12-Aug-96
1461028	M-24/L-94	12-Aug-96
1461029	M-24/L-54	12-Aug-96
1461030	M-25/L-04	12-Aug-96
1461031	M-24/L-66	12-Aug-96
1461032	M-24/L-66	12-Aug-96
1461033	M-24/L-117	13-Aug-96
1461034	M-24/L-63	13-Aug-96
1461035	M-25/L-07	13-Aug-96
1461036	M-25/L-08-IN	13-Aug-96
1461037	M-25/L-08-IN	13-Aug-96
1461038	M-24/L-72A	13-Aug-96
1461039	M-24/L-116	13-Aug-96
1461106	TOWN PARK	01-Aug-96
1461107	GW-73-S	01-Aug-96
1461108	GW-73-D	01-Aug-96

ATTACHMENT 3

ATTACHMENT 3

ACTIVITY AND USE LIMITATIONS

This attachment contains documentation of the limitations on activities and land/groundwater uses that have been assumed in the human health risk assessment. These attachments are draft documents for Limitations With Respect to Groundwater for the Main Street Residential Properties and for Downgradient Property Status and associated Groundwater Management Plans for Industrial Properties to the west of the Facility.

The Activity and Use Limitation for the facility Property has not yet been drafted. The results and conclusions of the human health risk assessment will become fully valid when the Activity and Use Limitation for the facility property is filed and stamped by the LSP of record and recorded, registered, or filed in accordance with the MCP.

DRAFT

DOWNGRADIENT PROPERTY STATUS OPINION

1.0 PURPOSE AND OBJECTIVES

This Downgradient Property Status (DPS) Opinion has been prepared in accordance with 310 CMR 40.0180 in support of the submittal for asserting Downgradient Property Status for the Property located at _______________., Wilmington, MA (Wilmington, MA Tax Assessor Map___, Lot ____) (the "Property" or "DPS Property"). The purpose of this Opinion is to present the technical basis for the conclusion that the criteria in 310 CMR 40.0183 (2) (b) have been met. This Opinion provides an explanation and documentation in support of its conclusions in accordance with the Performance Standard for a Downgradient Property Status Opinion as set forth in 310 CMR 40.0183 (4).

2.0 BACKGROUND

The DPS Property which is the subject of this Opinion is located in the southern portion of Wilmington, Massachusetts, downgradient of a facility owned by the Olin Corporation. Under the Massachusetts Contingency Plan (MCP), Olin Corporation has been conducting environmental investigations at the facility, located at 51 Eames Street in Wilmington, Massachusetts (the "Olin property"). This former chemical manufacturing facility was owned and operated by various companies since the early 1950s. Olin purchased the facility in 1980 and ceased manufacturing activities in 1986.

From 1953 to until approximately 1971, the Olin facility was operated under the name of National Polychemicals, Inc. (NPI). From 1953 to 1968, NPI was owned by three different corporations, American Biltrite Rubber Co., Fisons, Limited and Fisons Corporation. Fisons Corporation subsequently changed its name to NOR-AM Chemical Company. In 1968, Stepan Chemical Corporation purchased NPI; and in 1971, NPI was merged into Stepan Chemical Corporation. Stepan continued to own and operate the facility from 1971 until 1980, when it was purchased by Olin Corporation. Olin closed the facility in 1986.

The Olin facility historically manufactured chemical blowing agents, stabilizers, antioxidants, and other specialty chemicals for the rubber and plastics industry. The raw materials used at the facility included chromium dichromate until 1967. The manufacturing processes conducted at the facility generated certain types of liquid wastes including sulfuric acid, sodium chloride, sodium sulfate, ammonium sulfate, chromium sulfate, and other constituents. These wastes resulted in contamination at the facility.

The Olin property has been classified and issued a permit by the Massachusetts Department of Environmental Protection (MADEP) as a Tier IA site (MADEP Release Tracking Number (RTN): 3-0471) under the MCP. In 1993, a Comprehensive Site Assessment and Risk Assessment were submitted to the MADEP. A Supplemental Phase II Field Investigation has been in progress since 1994. The purpose of the Supplemental Phase II Field Investigation is to obtain additional data needed to evaluate remedial alternatives for addressing the contamination associated with the Olin property. The results of these investigations and an updated Risk Assessment are scheduled to be submitted to the MADEP in 1997. An Interim Update Report, dated June 1996, on the status of these investigations was submitted by Olin to the MADEP in July 1996.

The former manufacturing processes conducted at the Olin facility generated liquid wastes, which contained sulfuric acid, sodium chloride, sodium sulfate, ammonium sulfate, chromium sulfate, and other constituents, including oils and other organic compounds. Prior to 1970, the discharge of these wastes into unlined pits, Lake Poly, and other industrial disposal areas on the Olin property caused subsurface contamination both on and off the Olin property. The most extensive subsurface contamination is associated with a dense layer of inorganic contaminants that is present at the base of the sand and gravel aquifer. The dominant constituents of this layer are sulfate, chloride, ammonia, chromium, sodium, and calcium. The contamination at the facility is the result of several different activities that were conducted at the facility prior to Olin's ownership.

Because the dense inorganic layer is heavier than groundwater, it flows under the influence of gravity downhill along the top of the bedrock. Detailed seismic reflection surveys have been performed to the east, southwest, and west of the Olin property. The results of these surveys in conjunction with data obtained during well installations have been combined to provide a detailed picture of the shape of the bedrock surface. In the immediate vicinity of the Olin property, bedrock is at or near the ground surface. Bedrock is exposed at the ground surface along the railroad tracks, Eames Street, and to the southeast and southwest (Cook Avenue and Main Street) of the Olin property. From the Olin property there are two valleys incised in the bedrock, one towards the east and one towards the west. The Eastern Bedrock Valley does not extend much beyond Olin's eastern property line. The Western Bedrock Valley extends beneath Jewel Drive, Main Street near the intersection with Eames Street, and down under the wetlands surrounding Maple Meadow Brook. At its deepest, this valley is more than 100 feet below the ground surface. In the vicinity of the historic Middlesex Canal, the valley ends as the bedrock rises more than 50 feet above the bottom of the valley.

Movement of the dense layer is primarily controlled by the shape of the bedrock rather than by hydraulic heads and gradients. The waste material that was disposed into the unlined pits, Lake Poly, and other industrial disposal areas on the Olin property was an acidic liquid with high concentrations of dissolved solids, oils, and other organic compounds. This liquid was more dense than natural groundwater and so it tended to sink through the groundwater until it reached a less permeable barrier, the top of the bedrock. It was this process that created the dense layer that is currently present at the base of the aquifer in the vicinity of the Olin property. Once the dense liquid reached the bedrock, it continued to flow down slope along the top of the bedrock under the influence of gravity. Beneath the unlined pits, Lake Poly, and other industrial disposal areas where the liquid was disposed, the bedrock generally slopes to the west and southwest. Therefore, the dense material moved along the top of the bedrock towards the west and southwest.

In certain areas immediately adjacent to the western boundary of the Olin property, shallow groundwater quality has also been impacted. Concentrations of inorganic constituents have been detected in shallow groundwater in this area at elevated concentrations, although significantly lower than detected in the dense layer. The inorganic contamination is indicated by the presence of chloride, ammonia, sulfate, and occasionally chromium at elevated concentrations. Organic contaminants have also been detected in shallow groundwater in this area. Compounds that are indicative of contaminants originating at the Olin property include 2,4,4-trimethyl-1-pentene, 2,4,4-trimethyl-2-pentene, bis(2-ethylhexyl)phthalate and n-nitrosodiphenylamine.

3.0 EVALUATION OF THE BOUNDARIES OF THE SUBJECT PROPERTY

The subject DPS property is located at ___________________. in Wilmington, southwest of the Olin property. The boundaries of the DPS Property, as delineated on the Wilmington Tax Assessor's Map ____, Lot ____, are shown on Figures 1 and 2 of the Attachment A, attached hereto.

4.0 EVALUATION OF THE DISPOSAL SITE BOUNDARIES

Based on groundwater quality data obtained through its intensive investigation, Olin has developed maps which identify the location of contaminated groundwater on and off the Olin property. These maps are included as Figures 1 and 2, attached hereto as Attachment A. These maps were developed based on the interpretation of data obtained from the ongoing Supplemental Phase II Investigation as reported in the Interim Update Report (June 1996) and may be modified in the future as additional information is developed.

The location of the dense layer extends off the Olin property in the following areas:

Eastward within the Eastern Bedrock Valley to just beyond the railroad tracks, and

Westward within the Western Bedrock Valley beneath certain properties on Main Street, Eames Street, and Jewel Drive.

Areas where deep groundwater contains concentrations of sulfate greater than 250 mg/l (outside the dense layer) extend off the Olin property in the following areas:

Eastward to the East Ditch where deep groundwater discharges, and

Southwestward just beyond the limits of the Sulfate Landfill located in the southwestern corner of the Olin property.

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The area where shallow groundwater contains sulfate at concentrations greater than 250 mg/l covers most of the Olin property and extends offsite in the following areas:

Eastward to the East Ditch where shallow groundwater discharges,

Westward beneath some of the commercial properties on Jewel Drive, and

Southwestward just beyond the limits of the Sulfate Landfill.

It is concluded that the subject DPS Property lies within or immediately adjacent to the defined area(s) of contaminated groundwater downgradient of the Olin property.

5.0 EVALUATION OF KNOWN RELEASES AT THE DISPOSAL SITE

A detailed evaluation of the releases of regulated material at the Olin property and an assessment of current conditions are described in the aforementioned reports. As reported in the 1996 Interim Update Report, prior to 1970 all liquid wastes were discharged into various unlined pits in the central portion of the facility and into an unlined man-made excavation called Lake Poly, which overflowed into the onsite ditch system. In 1970, Stepan constructed an acid neutralization and treatment system and installed new lined lagoons. The treated wastewater was discharged to the onsite ditch system until the intermunicipal sewer system was completed in 1972. The remaining material, consisting primarily of calcium sulfate, was put into the lined settling lagoons. Periodically, these lagoons were dredged and the calcium sulfate was placed in a landfill on the southwest corner of the facility, now known as the Calcium Sulfate Landfill. Use of the Calcium Sulfate Landfill was approved by the Commonwealth of Massachusetts in the mid 1970s. After their purchase of the property, Olin relined the lagoons in 1981-1983. The lagoons and the Calcium Sulfate Landfill were closed after 1986 when operations at the facility ceased.

A dense layer of inorganic contaminants at the base of the aquifer, to the extent defined in the Interim Update Report, is shown on Figure 1 of Attachment A. The dense layer is generally characterized by specific gravity greater than water, a slight to deep green color, the presence of chromium, and sulfate concentrations greater than 3,000 mg/l. Chromium concentrations above GW-1 Reportable Concentrations have been consistently encountered in deep groundwater sampled from monitoring wells located within the dense layer.

Sulfate is the most common and most concentrated component of the inorganic contamination in shallow groundwater. Therefore, sulfate was selected in the Interim Update Report as the best single parameter to indicate the presence of inorganic contamination in the shallow groundwater. Shallow groundwater where sulfate was detected, to the extent defined in the Interim Update Report, at concentrations greater than 250 mg/l is presented on Figure 2 of Attachment A.

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Other regional factors may also have an impact on the quality of groundwater. The area surrounding the DPS Property is dominated by industrial and commercial land use, and thus contaminants other than those emanating from the Olin facility may be present. In addition, groundwater in the area west of the Olin property is classified under the MCP as GW-1 in certain areas and GW-2 in others. In view of the general groundwater conditions in the area, including but not limited to the classification of a portion of the groundwater as GW-2, groundwater should not be used for potable purposes.

A search of the Massachusetts Department of Environmental Protection (MADEP) 21E site lists and/or databases was performed most recently on January 29, 1997. The search on the ______________________ property at ______________________ (Parcel No. _______) showed that this property is not listed. There is no record of any historical spills at this address. This address does not appear on the August 1993 Transition List of Confirmed Disposal Sites and Locations to be Investigated (or addenda thereto) nor in MADEP's "Front End" database, which tracks releases reported after October 1, 1993. The MADEP Front End database was last updated on January 8, 1997.

In connection with the application for Downgradient Property Status for the above-referenced Property, an Owner Questionnaire and Certification regarding any known releases of oil and/or hazardous material at this Property is included as Attachment B hereto.

6.0 EVALUATION OF THE RELEVANT HYDROGEOLOGIC CONDITIONS

Movement of the dense layer is primarily controlled by the shape of the bedrock rather than by hydraulic heads and gradients. Beneath the unlined pits and Lake Poly where the waste material was disposed, the bedrock generally slopes to the west and southwest. The waste material was an acidic liquid with high concentrations of dissolved solids, oils, and other organic compounds. This liquid was more dense than natural groundwater and so it tended to sink through the groundwater until it reached a less permeable barrier, the top of the bedrock. It was this process that created the dense layer that is currently present at the base of the aquifer in the vicinity of the Olin property. Once the dense liquid reached the bedrock, it continued to flow down slope along the top of the bedrock under the influence of gravity. Therefore, the dense material moved along the top of the bedrock towards the west and southwest in the Western Bedrock Valley.

Shallow groundwater flow in the area west of the Olin property is controlled by a very shallow hydraulic gradient. The shallow groundwater flow direction in the area immediately west of the Olin property is generally towards the drainage ditches and may change seasonally towards the Maple Meadow Brook wetlands.

7.0 EVALUATION OF THE NEED TO CONDUCT AN IMMEDIATE RESPONSE ACTION

There is no need to conduct an immediate response action (IRA) at the subject DPS Property, based on:

The releases which occurred at the Olin property are the subject of an extensive ongoing evaluation in the Supplemental Phase II Investigation Program with MADEP oversight;

The subject DPS Property is not a current user of groundwater; and

A DPS Groundwater Management Plan, which provides guidance as an appropriate interim risk reduction measure for management of groundwater resources at the subject DPS Property, is included as Attachment C hereto. Maintenance and compliance with the DPS Groundwater Management Plan at the DPS Property will prevent, eliminate, or minimize any risk of future exposure to the contaminated groundwater.

8.0 LSP OPINION

Based upon the conclusion that the criteria in 310 CMR 40.0183(2)(b) have been met, it is the opinion of Jeffrey D. Bradshaw, LSP, that the subject Property qualifies for Downgradient Property Status.

9.0 SEAL AND SIGNATURE

LSP Name: ______________________________ Stamp:

LSP No.: ______________________________

Signature: ______________________________

Date: ______________________________

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ATTACHMENT B

DPS OWNER QUESTIONNAIRE AND CERTIFICATION

In connection with the Application for Downgradient Property Status ("DPS") for the above-referenced property, pursuant to the Massachusetts Contingency Plan, 310 CMR 40.0180 et seq., I certify the following information to be true, accurate and complete, to the best of my knowledge and belief:

1. I am fully authorized to make this attestation on behalf of , (" ").

2. is the owner of real property located at (Map , Lot) in Wilmington, Massachusetts (the "DPS Property").

3. has owned the DPS Property for years.

4. I understand that Olin Corporation is the current owner of real property located at 51 Eames Street, Wilmington, Massachusetts (the "Olin Property").

5. I have been informed of the presence of certain contamination in groundwater that has migrated from the Olin Property (DEP/RTN: 3-0471) (the "Upgradient Release"). I have further been informed that the Upgradient Release has migrated beneath the DPS Property. I have been provided a copy of and have read the DPS Opinion, prepared by Jeffrey Bradshaw, a Licensed Site Professional and dated __________________, 1997, with regard to the Upgradient Release.

6. To the best of my knowledge, information and belief, after having made due inquiry, I am not aware of any activities by occurring at the DPS Property that have contributed to the Upgradient Release, or have caused it to become worse than it otherwise would have been.

7. To the best of my knowledge, information and belief, after having made due inquiry, is not, and has not been at any time, affiliated with Olin Corporation or with any of the entities who owned or operated the Olin Property, including Stepan Chemical Company, National Polychemicals, Inc., American Biltrite Rubber Company, Fisons Limited, Fisons Corporation, NOR-AM Chemical Company or Agr-Evo U.S.A.

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8. Any response actions performed by in connection with the Upgradient Release and or the Olin disposal site have been performed in compliance with the requirements and procedures in M.G.L. c. 21E and 310 CMR 40.0000 (Massachusetts Contingency Plan).

Please check one: Applicable _____ Not Applicable _____

Signed this ______ day of ________, 1997 under the penalties of perjury.

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ATTACHMENT C

DOWNGRADIENT PROPERTY STATUS GROUNDWATER MANAGEMENT PLAN

I. Purpose and Objectives

This Downgradient Property Status Groundwater Management Plan (the "Management Plan") is prepared in accordance with the Massachusetts Contingency Plan ("MCP"), 310 CMR 40.0185, for maintenance of Downgradient Property Status ("DPS"). The purpose of this Management Plan is to provide the owner and operator of the DPS Property identified below with a strategy to:

- Prevent the exposure of human and environmental receptors to hazardous material at the downgradient property which is the subject of the DPS Submittal;
- Prevent an act by the owner/operator of the DPS Property to cause the release to become worse than it otherwise would be; and
- Avoid an activity which could prevent or impede the implementation of reasonably likely response actions in the future.

This Management Plan is intended to serve as guidance for management of groundwater resources by the owner and/or operator of the DPS Property. Maintenance of DPS Status requires compliance with 310 CMR 40.0185.

II. Nature of Groundwater Conditions Warranting Management Plan

The DPS Property is located at (Wilmington, MA Tax Assessors' Map Lot) in the southern section of Wilmington, Massachusetts, in a largely industrial and commercial area. The DPS Property is downgradient of a former chemical manufacturing facility currently owned by Olin Corporation, located at 51 Eames Street, Wilmington, Massachusetts (the "Olin Property") (DEP/RTN:3-0471). According to the ongoing Supplemental Phase II Investigation of the Olin Property as reported in the Interim Update Report (June 1996), disposal of certain liquid wastes at the Olin Property prior to its ownership has resulted in groundwater contamination in the area to the west and southwest of the facility and beyond Main Street.

Due to its density, deep groundwater contamination occurs in a dense layer within a limited zone at the base of the unconsolidated sediments at the top of the bedrock. The key indicators of this dense layer include sulfate, chloride, ammonia,

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and chromium, sodium and calcium. Generally, the shallow groundwater above this dense layer is not significantly impacted by such contamination and its use, therefore, may be suitable for non-potable purposes. However, due to the presence of the deeper contamination, the location, depth, potential use and installation of groundwater withdrawal wells must be given sufficient consideration so that the contamination is not disturbed and released into the shallow groundwater and that a potential route of exposure to workers and others is not thereby created.

In certain areas immediately adjacent to the western boundary of the Olin property, shallow groundwater quality has also been impacted by inorganic contaminants, but to a much lesser degree than in the dense layer, as well as by certain organic contaminants. The shallow groundwater in this area may be suitable for certain non-potable uses, given due consideration of the proposed use and the expected water quality.

Other regional factors may also have an impact on the use of groundwater. The area surrounding the DPS Property is dominated by industrial and commercial land use, and thus contaminants other than those emanating from the Olin facility may be present. In addition, groundwater in the area west of the Olin Property is classified under the MCP as both GW-1 in certain areas and GW-2 in others. In view of the general groundwater conditions in the area, including but not limited to the classification of a portion of the groundwater as GW-2, groundwater should not be used for potable purposes.

III. Strategy for Management of Groundwater Resources

Prior to initial use of, or modification to its use of, the groundwater for non-potable purposes, the DPS owner/operator will comply with the following requirements:

A. Evaluation of water available within a safe yield. In accordance with good engineering practices, any DPS owner/operator seeking to utilize groundwater will need to conduct an appropriate hydrogeologic analysis to evaluate the owner/operator's proposed water requirements, to determine the natural yield of the aquifer, and if the yield is sufficient, to identify the pumping rate that will not result in disturbance of the contamination in the deep aquifer. Consideration will also need to be given to anticipated times of year when the withdrawal is or will be made.

Olin Corporation will cooperate with the DPS owner/operator in providing data and other information it has developed in connection with its investigation and assessment of site conditions pursuant to M.G.L. c. 21E and the MCP, about geologic and groundwater conditions to assist the DPS owner/operator in its efforts to evaluate the hydrogeologic conditions and non-potable use of groundwater.

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B. Evaluation of impact of proposed water withdrawal on assessment and remediation efforts. The DPS owner/operator will notify and consult with Olin Corporation prior to conducting any hydrogeologic analyses to ensure that such analyses and/or proposed withdrawal of groundwater will not interfere with or prevent or impede Olin's assessment or implementation of response actions with respect to contaminated groundwater from the Olin site.

C. Evaluation of health and safety considerations. Any person undertaking an activity with the potential to contact contaminated groundwater will prepare and implement a worker health and safety plan to the extent required by the federal Occupational Safety and Health Administration (OSHA) and any other applicable federal, state, or local law. The scope and detail of health and safety procedures should be commensurate with the degree and nature of the risks posed to human and ecological populations by the release and/or activity.

D. Notification and Application to State and Local Authorities. Board of Health regulations for the Town of Wilmington require that a permit be obtained prior to the installation of any groundwater well within the town, regardless of its size or intended use. Pursuant to this Management Plan, the DPS owner/operator shall notify in writing the Bureau of Waste Site Cleanup, Northeast Region, Massachusetts Department of Environmental Protection ("DEP") prior to the installation of any wells on the DPS Property and/or at the time the Board of Health application is made. The DEP notification will identify the property as a DPS Property with respect to the Olin Property.

In addition, other notifications and permits may be required for the withdrawal of groundwater, depending upon its size and prospective use. For example, a permit must be obtained from the DEP pursuant to 310 C.M.R. 36.00, in the event that the proposed withdrawal exceeds 100,000 gallons per day.

E. Consideration of State and Local Groundwater Resources Management Plans and Other Parties' Withdrawals. DPS owners/operators seeking to withdraw groundwater should consult with local and state authorities to identify any local or regional groundwater management or aquifer protection plans which may affect groundwater withdrawal. In addition, consideration of the impact of the withdrawal on withdrawals at other properties nearby should be evaluated.

F. Potable Use Prohibited. In view of the general groundwater conditions in the area, groundwater should not be used for potable purposes.

G. Consideration of other federal, state, and local laws and regulations. The considerations identified above are not intended to replace, nor excuse compliance with, any other applicable federal, state or local governing the withdrawal and use of groundwater.

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IV. Post-Well Installation Monitoring and Testing

Results of any groundwater quality test and/or well performance monitoring at the DPS Property shall be forwarded to the Wilmington Board of Health, the DEP, and Olin.

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GROUNDWATER LIMITATION OPINION

1.0 PURPOSE AND OBJECTIVES

This Groundwater Limitation Opinion ("LSP Opinion") has been prepared in accordance with M.G.L. c. 21E and the Massachusetts Contingency Plan (MCP), 310 CMR 40.0000 in support of the Notice of Limitation With Respect to Groundwater and Restriction and Easement Agreement ("Notice of Limitation") for the property located at________________________, Wilmington, MA Tax Assessor Map ___, Lot ___) (the "Property"). The purpose of the Notice of Limitation is as a preliminary response action being taken to prevent exposure to contaminated groundwater while comprehensive site assessment and cleanup options are being pursued. This LSP Opinion provides a discussion of:

1. Why the Notice of Limitation is appropriate;
2. Site activities and uses to be prohibited and/or limited;
3. Site activities and uses to be permitted; and
4. Obligations and conditions necessary to meet the objectives of the Notice of Limitation.

2.0 BACKGROUND

The Property which is the subject of this LSP Opinion is located in the southern portion of Wilmington, Massachusetts, downgradient of a facility owned by the Olin Corporation. Under the MCP, Olin Corporation has been conducting environmental investigations at the facility, located at 51 Eames Street in Wilmington, Massachusetts (the "Olin property"). This former chemical manufacturing facility was owned and operated by various companies since the early 1950s. Olin purchased the facility in 1980 and ceased manufacturing activities in 1986.

From 1953 to until approximately 1971, the Olin facility was operated under the name of National Polychemicals, Inc. (NPI). From 1953 to 1968, NPI was owned by three different corporations, American Biltrite Rubber Co., Fisons, Limited and Fisons Corporation. Fisons subsequently changed its name to NOR-AM Chemical Company, and then to Agr-Evo U.S.A. In 1968, Stepan Chemical Corporation purchased NPI; and in 1971, NPI was merged into Stepan Chemical Corporation. Stepan continued to own and operate the facility from 1971 until 1980, when it was purchased by Olin Corporation. Olin closed the facility in 1986.

The Olin facility historically manufactured chemical blowing agents, stabilizers, antioxidants, and other specialty chemicals for the rubber and plastics industry. The raw materials used at the facility included chromium until 1967. The manufacturing processes conducted at the facility generated certain types of liquid wastes including sulfuric acid, sodium chloride, sodium sulfate, ammonium sulfate, chromium sulfate, and other constituents. These wastes resulted in contamination at the facility.

The Olin property has been classified and issued a permit by the Massachusetts Department of Environmental Protection (MADEP) as a Tier IA site (MADEP Release Tracking Number (RTN): 3-0471) under the MCP. In 1993, a Comprehensive Site Assessment and Risk Assessment were submitted to the MADEP. A Supplemental Phase II Field Investigation has been in progress since 1994. The purpose of the Supplemental Phase II Field Investigation is to obtain additional data needed to evaluate remedial alternatives for addressing the contamination associated with the Olin property. The results of these investigations and an updated Risk Assessment are scheduled to be submitted to the MADEP in 1997. An Interim Update Report, dated June 1996, on the status of these investigations was submitted by Olin to the MADEP in July 1996.

The manufacturing processes conducted at the Olin facility generated liquid wastes, including sulfuric acid, sodium chloride, sodium sulfate, ammonium sulfate, chromium sulfate, and other wastes, including oils and other organic wastes. The discharge of these wastes into unlined pits, Lake Poly, and other industrial disposal areas on the Olin property beginning in the early 1950s caused subsurface contamination both on and off the Olin property. The most extensive subsurface contamination is associated with a dense layer of inorganic contaminants that is present at the base of the sand and gravel aquifer. The dominant constituents of this layer are sulfate, chloride, ammonia, chromium, sodium, and calcium. The contamination at the facility is the result of several different activities that were conducted at the facility prior to Olin's ownership.

Because the dense inorganic layer is heavier than groundwater, it flows under the influence of gravity downhill along the top of the bedrock. Detailed seismic reflection surveys have been performed to the east, southwest, and west of the Olin property. The results of these surveys in conjunction with data obtained during well installations have been combined to provide a detailed picture of the shape of the bedrock surface. In the immediate vicinity of the Olin property, bedrock is at or near the ground surface. Bedrock is exposed at the ground surface along the railroad tracks, Eames Street, and to the southeast and southwest (Cook Avenue and Main Street) of the Olin property. From the Olin property there are two valleys incised in the bedrock, one towards the east and one towards the west. The Eastern Bedrock Valley does not extend much beyond Olin's eastern property line. The Western Bedrock Valley extends beneath Jewel Drive, Main Street near the intersection with Eames Street, and down under the wetlands surrounding Maple Meadow Brook. At its deepest, this valley is more than 100 feet below the ground surface. In the vicinity of the historic Middlesex Canal, the valley ends as the bedrock rises more than 50 feet above the bottom of the valley.

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3.0 WHY THE NOTICE OF LIMITATION IS APPROPRIATE

Movement of the dense layer is primarily controlled by the shape of the bedrock rather than by hydraulic heads and gradients. Beneath the unlined pits and Lake Poly where the waste material was disposed, the bedrock generally slopes to the west and southwest. The waste material was an acidic liquid with high concentrations of dissolved solids, oils, and other organic compounds. This liquid was more dense than natural groundwater and so it tended to sink through the groundwater until it reached a less permeable barrier, the top of the bedrock. It was this process that created the dense layer that is currently present at the base of the aquifer in the vicinity of the Olin property. Once the dense liquid reached the bedrock, it continued to flow down slope along the top of the bedrock under the influence of gravity. Therefore, the dense material moved along the top of the bedrock towards the west and southwest in the Western Bedrock Valley. This process continued until the dense extended near or beneath the subject Property, as shown on Exhibit B of the Notice of Limitation.

Deep groundwater is not currently used for potable or nonpotable purposes and thus does not present an unacceptable risk under current conditions. However, the potential use of deep groundwater is a possible future exposure pathway. Therefore, activity and use limitations prohibiting the use or disturbance of deep groundwater underlying the subject Property are required as an interim risk reduction measure to prevent potential exposure to the contamination in the groundwater.

An objective of the groundwater use restrictions is also to prevent pumping of shallow groundwater which may result in disturbance of the deeper groundwater and potential introduction of contamination into the shallow groundwater. Therefore, any existing private water supply well on the subject property must be properly abandoned in accordance with Massachusetts regulations.

4.0 SITE ACTIVITIES AND USES TO BE PROHIBITED AND/OR LIMITED

Activities and uses which are inconsistent with this LSP Opinion, and are therefore prohibited. are as follows:

- Removal of the sealant or other substance used in abandoning any private water supply well(s) located within the Property;
- Installation of a water supply well within the Property;
- Withdrawal of groundwater for any purpose, other than sampling or testing without prior notification to MADEP to determine if approval is necessary;

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- Drilling or otherwise accessing the subsurface at a depth greater than 30 feet, without prior notification to MADEP to determine if approval is necessary.

5.0 SITE ACTIVITIES AND USES TO BE PERMITTED

Activities and uses which are consistent with this LSP Opinion and therefore permitted, if implemented at the Property, are:

- All activities above the ground surface, including, but not limited to, gardening and landscape maintenance;

- Shallow soil excavation and emplacement of material in the shallow subsurface (less than 30 feet deep), including, but not limited to, septic leach fields, building foundations, underground utilities, landscaping and grading, and swimming pools; and

- Installation and sampling of groundwater monitoring equipment, with prior notification to MADEP to determine if approval is necessary.

6.0 OBLIGATIONS AND CONDITIONS

Obligations and conditions necessary to prevent potential human or environment exposure to the contamination in groundwater are:

- It shall be the obligation of the Property owner to maintain compliance with the conditions of these limitations on activities and uses with respect to groundwater at the Property.

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7.0 SEAL AND SIGNATURE

LSP Name: ______________________ Stamp:

LSP No.: ______________________

Signature: ______________________

Date: ______________________

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NOTICE OF LIMITATION WITH RESPECT TO GROUNDWATER
AND RESTRICTION AND EASEMENT AGREEMENT
M.G.L.c.21E, §6 and 310 CMR 40.0000

This notice of Limitation with Respect to Groundwater and Restriction and Easement Agreement ("Notice of Limitation") is made as of this ____________ day of ____________, 19__, by and between the undersigned.

W I T N E S E T H:

WHEREAS, ________________ (the "Owner"), of Wilmington, Middlesex County, Massachusetts, is the owner in fee simple of certain land together with the buildings and improvements thereon in Wilmington, Middlesex County, Massachusetts, located at ____[address], which land is more particularly bounded and described in Exhibit A attached hereto and made a part hereof (the "Property"). The Property is shown on a plan [recorded and/or registered herewith] [recorded and/or registered in ________________ County Registry of Deeds/Land Registration Office in Plan Book ______, Plan _____, or as Land Court Plan No. ______];

WHEREAS, Olin Corporation, a Virginia corporation with a principal place of business in Norwalk, Connecticut, ("Olin") is the owner of certain land together with the buildings and improvements thereon in Wilmington, Middlesex County, Massachusetts, which land is described more particularly in a deed from _________ to Olin, dated __________, recorded with Middlesex North District Registry of Deeds at Book____, Page____, (the "Olin Land");

WHEREAS, oil and/or hazardous materials released in the past at the Olin Land have come to be present in the groundwater beneath certain properties in the vicinity of the Olin Land (DEP/RTN: 3-0471), including the Property (the "Contamination") and the Property comprises part of a disposal site as the result of the Contamination. Exhibit B is a Sketch Plan showing the relationship of the Property subject to this Notice of Limitation with Respect to Groundwater, and Restriction and Easement Agreement to the boundaries of said disposal site (to the extent such boundaries have been established). Exhibit B is attached hereto and made a part hereof;

WHEREAS, certain investigations and response actions have been performed and will continue to be performed by Olin in connection with the remediation of the Contamination in accordance with Massachusetts General Laws c. 21E ("Chapter 21E") and the Massachusetts Contingency Plan, 310 CMR 40.0000 ("MCP");

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WHEREAS, such investigations and response actions have determined that no imminent hazard to health, safety, public welfare or the environment exists at the Property but have indicated that certain precautionary and prudent interim risk reduction measures are warranted under the MCP. The basis for such restrictions is set forth in a Groundwater Limitation Opinion ("LSP Opinion"), dated __________, prepared by ________________, a Licensed Site Professional ("LSP" as that term is defined in the MCP, 310 CMR 40.0006) (which is attached hereto as Exhibit C and made a part hereof); and

WHEREAS, these risk reduction measures include the following: (i) the connection of the Property to a public water supply system, if applicable; (ii) the closing of any private water supply well(s) located within the Property; and (iii) the implementation of this Notice of Limitation prohibiting use of any private water supply and any installation of new private water supplies within the Property; and

WHEREAS, the Property is currently used and is anticipated in the future to be used for residential purposes; and

WHEREAS, the Property has been connected to a public water supply system as is confirmed in the attached LSP Opinion;

NOW THEREFORE, for good and valuable consideration and payment made by Olin to Owner, the receipt and sufficiency of which is hereby acknowledged, Olin and the Owner hereby agree, and notice is hereby given as follows:

1. Notice of Limitation with Respect to Groundwater. Notice is hereby given by the Owner that, with the exception of the activities described in Paragraph 2 below, the activity and use limitations set forth in the LSP Opinion are that there shall be no access to and/or use of, groundwater for private water supply or other purposes.

2. Permitted Activities and Uses Set Forth in the LSP Opinion. Activities and uses which are consistent with this LSP Opinion and therefore permitted, if implemented at the Property, are:

- All activities above the ground surface, including, but not limited to, gardening and landscape maintenance;
- Shallow soil excavation and emplacement of materials in the shallow subsurface (less than 30 feet deep), including, but not limited to, septic leach fields, building foundations, underground utilities, landscaping and grading, and swimming pools; and

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- Installation and sampling of groundwater monitoring equipment.

3. Activities and Uses Inconsistent with the LSP Opinion. Activities and uses which are inconsistent with the objectives of this Notice of Limitation, and which, if implemented at the Property, may result in human or environmental exposure to the Contamination in the groundwater are as follows:

(i) Removal of the sealant or other substance used in abandoning any private water supply well(s) located within the Property;
(ii) installation of a water supply well within the Property;
(iii) Withdrawal of groundwater for any purpose other than sampling or testing without prior notification to the Massachusetts Department of Environmental Protection ("DEP") to determine if approval is necessary; and
(iv) Drilling or otherwise accessing the subsurface at a depth greater than 30 feet, without prior notification to DEP to determine if approval is necessary.

4. Obligations and Conditions Set Forth in the LSP Opinion. Obligations and/or conditions to be undertaken and/or maintained at the Property to continue to prevent potential human or environmental exposure to the Contamination in groundwater as set forth in the LSP Opinion shall include the following:

(i) It shall be the obligation of the Owner to maintain compliance with the conditions of these limitations on activities and uses with respect to groundwater at the Property.

5. Violation of the Limitation with Respect to Groundwater. In order to continue to prevent potential human or environmental exposure to the Contamination in groundwater, neither the activities and uses which are permitted hereunder, nor those which are prohibited, shall be changed by the Owner, or by anyone claiming by, through or under the Owner, so as to result in human or environmental exposures to the Contamination in groundwater, without prior evaluation by an LSP acting for or on behalf of Olin, and without additional response actions, if necessary. If the activities, uses, and/or exposures upon which this Notice of Limitation is based change without the prior evaluation and additional response actions determined to be necessary by an LSP acting for or on behalf of Olin, the Owner of the Property at the time that the activities, uses and/or

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exposures change, shall comply with the requirements for reevaluation of the basis of this Notice of Limitation as provided in the MCP. In any event, no such change shall be effective unless consented to by DEP and Olin and notice of such consent is recorded in the Middlesex North District Registry of Deeds.

6. Restriction Imposed for the Benefit of the Olin Land.

(i) In furtherance of the purposes of the LSP Opinion and this Notice of Limitation, the Owner hereby imposes on the Property for the benefit of the Olin Land the restriction (the "Restriction") that the Owner shall not use the groundwater beneath the Property for private water supply or other purposes.

(ii) The Owner and Olin agree that it is their intention that the foregoing Restriction touch and concern both the Property and the Olin Land, and that any violation of the Restriction by the Owner might negatively impact the extent of the Contamination. In addition, the aforesaid Restriction shall run with the Property and the Olin Land, and shall inure to the benefit of the Olin Land and be enforceable by the owner of the Olin Land, and shall burden the Property and be enforceable against the Owner of the Property.

(iii) This Restriction shall be in effect for a period of thirty (30) years from the date of recording this Notice of Limitation and Agreement and may be extended by Olin for such periods and in such fashion as are set forth in M.G.L. c.184, §27, as amended or any similar successor provisions.

7. Easement to Enforce Restriction. The Owner hereby grants to Olin for the benefit of the Olin Land an easement to enter upon the Property to enforce the Restriction and, in connection therewith, Olin, and its agents, employees and consultants, may remove any device which provides access to the groundwater, and may undertake any other activity which is reasonably necessary to prevent the Contamination in groundwater from reaching the surface of the Property; provided, however, that in the event that Olin exercises its rights under this easement, Olin agrees to use reasonable efforts to restore the surface of the Property to its condition immediately prior to such entry insofar as is reasonably practicable.

8. Inspection Easement. The Owner hereby grants to Olin for the benefit of the Olin Land an easement to enter upon the Property for the purpose of performing an investigation or environmental assessment of the Contamination in the groundwater beneath the Property. In the event that Olin exercises its

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rights hereunder, Olin agrees to provide reasonable notice to the Owner in advance of entering the Property, to use reasonable efforts to restore the surface of the Property to its condition immediately prior to such entry insofar as is reasonably practicable, and to otherwise take reasonable steps to cooperate with the Owner to eliminate inconvenience caused by such entering as reasonably practicable.

9. Incorporation Into Deeds, Mortgages, Leases, and Instruments of Transfer. This Notice of Limitation shall be incorporated either in full or by reference into all deeds, easements, mortgages, leases, licenses, occupancy agreements or any other instrument of transfer, whereby an interest in and/or a right to use the Property or a portion thereof is conveyed.

Owner hereby authorizes and consents to the filing and recordation and/or registration of this Notice of Limitation, said Notice of Limitation to become effective when executed under seal by the undersigned LSP, and recorded and/or registered with the Middlesex North Registry of Deeds and/or Land Registration Office.

10. Amendment of Notice of Limitation. Owner agrees that this Notice of Limitation may be amended by Olin at any time based upon new information, a change in the condition of the Contamination in groundwater or other appropriate circumstances, provided such amendment is made in accordance with M.G.L. c. 21E and MCP and does not create additional material restrictions on Owner's use of the Property. Any amendment of this Notice of Limitation to support a Response Action Outcome (RAO), as defined in the MCP, must use the form and language for an Activity and Use Limitation as provided in the MCP to support such an RAO. Owner agrees to execute such amendment, and hereby authorizes and consents to the filing and recordation and/or registration of such amendment to this Notice of Limitation of LSP with the Middlesex North Registry of Deeds and/or Land Registration Office.

11. Successors and Assigns. Any reference herein to the Owner or Olin shall include their respective heirs, assigns and successors in title to the Property or the Olin Land, as the case may be.

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WITNESS the execution hereof under seal this ____________ day of ____________, 19____.

____
Owner

COMMONWEALTH OF MASSACHUSETTS

______________, ss   ________________, 19__

Then personally appeared the above named __________ and acknowledged the foregoing to be his/her free act and deed before me,

____
Notary Public
My commission expires:

____
OLIN CORPORATION

COMMONWEALTH OF MASSACHUSETTS

______________, ss   ________________, 19__

Then personally appeared the above named __________ and acknowledged the foregoing to be his/her free act and deed before me,

____
Notary Public
My commission expires:

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The undersigned LSP hereby certifies that he/she executed the aforesaid Groundwater Limitation Opinion attached hereto as Exhibit C and made a part hereof and that in his/her Opinion this Notice of Limitation with Respect to Groundwater is consistent with the terms set forth in said Groundwater Limitation Opinion.

Date: ____________

____
LSP

[LSP SEAL]

COMMONWEALTH OF MASSACHUSETTS

________________, ss ________________, 19__

Then personally appeared the above named __________ and acknowledged the foregoing to be his/her free act and deed before me,

____
Notary Public
My commission expires:

Upon recording, return to:

(Name and Address of Owner)

ATTACHMENT 4

ATTACHMENT 4

DOSE-RESPONSE DATA AND RELATIVE ABSORPTION FACTORS

This attachment presents the dose-response information used in the human health risk characterization toxicity assessment, and the relative absorption factors used in the human health risk characterization exposure assessment.

Specifically, this attachment contains the following information:

- Short Toxicity Profiles for Site-Related Oil and Hazardous Material of Concern
- Oral Dose-Response Data (Carcinogenic Effects) - Table A4-1
- Inhalation Dose-Response Data (Carcinogenic Effects) - Table A4-2
- Oral Dose-Response Data (Noncarcinogenic Effects) - Table A4-3
- Inhalation Dose-Response Data (Noncarcinogenic Effects) - Table A4-4
- Development of a Groundwater Concentration Limit for Diisobutylene
- Derivation of a Chronic Oral Reference Dose for Dinitrosopentamethylene (OPEX™)
- Derivation of a Chronic Oral Reference Dose for Azodicarbonamide (Kempore™)
- Oral Toxicity Assessment for Cobalt
- Relative Absorption Factors (Carcinogenic Effects) - Table A4-5
- Relative Absorption Factors (Noncarcinogenic Effects) - Table A4-6
- Permeability Constants - Table A4-7

SHORT TOXICITY PROFILES FOR SITE-RELATED FREQUENTLY DETECTED OHM OF CONCERN

1,2-Dichlorobenzene. 1,2-Dichlorobenzene has been used as a solvent, fumigant, insecticide, and chemical intermediate. 1,2-Dichlorobenzene is a central nervous system (CNS) depressant. Chronic exposure to this chemical causes hepatotoxicity and renal toxicity. 1,2-Dichlorobenzene has been classified by EPA in group D, not classifiable regarding carcinogenicity.

References:

Clayton, George D. and Florence E. Clayton, editors, 1981. Patty's Industrial Hygiene and Toxicology, 3rd Revised Edition; John Wiley & Sons; New York.

United States Environmental Protection Agency. Integrated Risk Information System (IRIS), 1993.

1,3-Dichlorobenzene. Commercial production of 1,3-dichlorobenzene is negligible. It has potential uses as a pesticide or fumigant. 1,3-Dichlorobenzene may occur as a contaminant of 1,2- or 1,4-dichlorobenzene formulations. There is limited information on toxicity of 1,3-dichlorobenzene. There are no carcinogenicity data available. Statistically significant, dose-related increases in micronuclei were observed in bone marrow cells of male mice injected intraperitoneally with 1,3-dichlorobenzene. However, no reversions significantly above control were observed in the Salmonella/microsome assay, in an E. coli reversion test, or in Bacillus subtilis DNA-deficient repair test. In rats, no teratogenic effects were observed. Liver dysfunction and minimal liver necrosis were observed in rats following exposure to 1,3-dichlorobenzene. In vivo studies in rats, in which hepatotoxic effects of three dichlorobenzenes were compared, indicated that the isomers tested can be ranked by toxicity as follows: 1,2-dichlorobenzene>1,3-dichlorobenzene>1,4-dichlorobenzene. 1,3-dichlorobenzene is classified by USEPA as a D, not classifiable to human carcinogenicity.

References:

The Installation Restoration Program Toxicology Guide, 1989. Dibromochloromethane. The Installation Restoration Program Toxicology Guide, Volume 2.

1,4-Dichlorobenzene. 1,4-Dichlorobenzene has been used as mothballs, an insecticidal fumigant, a germicide, and a space deodorant. Human exposure to 1,4-dichlorobenzene has produced irritation to skin, throat, and eyes; prolonged exposure to high concentrations may cause weakness, dizziness, loss of weight, or liver injury. In several studies involving female rats and mice, no overt signs of toxicity were apparent at any exposure level. Non-tumor and tumor pathology did not indicate any treatment related effect of either species. An embryotoxicity and teratology study on rats did not demonstrate any signs of embryo- or phytotoxicity or teratogenicity at any exposure level (Loeser, 1983). In a series of mutagenicity tests, 1,4-dichlorobenzene did not produce a mutagenic response. (Loeser, 1983). Other exposure studies in rats have produced developmental abnormalities, phytotoxicity, and kidney tumors. Additional exposure studies in animals have produced histological changes in the lung, cirrhosis and necrosis of the liver, and swelling of the tubular epithelium of the kidneys. 1,4-Dichlorobenzene has been classified by the USEPA as a group C carcinogen, possibly carcinogenic to humans.

References:

United States Environmental Protection Agency. Health Effects Summary Tables (HEAST), 1993.

Loeser E, Litchfield MH, 1983. Food Chem Toxicol 21 (6): 825-32.

Acenaphthene. Acenaphthene is a member of the polycyclic aromatic hydrocarbon (PAH) class of organic compounds. Unlike a number of PAHs, which have no known use, acenaphthene has a use in the manufacture of plastics and as an insecticide and fungicide. Toxicological data are extremely limited for acenaphthene. However, as a two-ring PAH, acenaphthene is a closer structural analog to naphthalene than it is to multi-ring PAHs such as benzo(a)pyrene, chrysene, or phenanthrene. Therefore, toxicities induced by acenaphthene may be similar to those induced by naphthalene. PAHs as a class of compounds are absorbed by inhalation, oral, and dermal routes, and have been associated with atherosclerosis, cancer, and reproductive effects in humans and animals. However, mutagenicity and cancer tests for acenaphthene were negative.

References:

ATSDR, 1989. Toxicological Profile for Polycyclic Aromatic Hydrocarbons. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, October, 1989.

International Agency for Research on Cancer, 1983. *Monograph on the evaluation of carcinogenic risk of chemicals to man: polynuclear aromatic hydrocarbons.* 32:33-43.

USEPA, 1981. An exposure and risk assessment for acenaphthene. U.S.EPA Contract No. 68-01-6017. Office of Water Regulations and Standards, Washington, D.C.

__Acenaphthylene__. Acenaphthylene is a member of the polycyclic aromatic hydrocarbon (PAH) class of compounds which contain two or more aromatic rings. PAHs are ubiquitous in nature and are also man-made. Acenaphthylene occurs naturally in coal tar, crude oil, and is formed from incomplete combustion of organic material. It is also a product of pyrolysis in tobacco smoke. Data on acenaphthylene are extremely limited. A single genotoxicity study on acenaphthylene was positive; however, the carcinogenicity of this compound has not been assessed. Based on its structural similarity to acenaphthene, acenaphthylene may posses similar toxicological properties. The USEPA has not derived a reference dose for acenaphthylene.

References:

MADEP, 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6"; Policy #WSC/ORS-142-92; Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, MA; September 1992.

__Acetone__. Acetone is found both naturally in the environment, resulting from the breakdown of fat in the body, and is also used as a solvent in manufacturing plastics, fibers, drugs, and other pharmaceuticals. Workers occupationally exposed to acetone complained of respiratory tract and eye irritation. At higher doses, workers reported headaches, feelings of light-headedness and confusion. The USEPA toxicity value for acetone is based on changes in liver weight and kidney toxicity observed in rats. Information on the carcinogenicity of acetone is inadequate to classify it as carcinogenic.

References:

Agency for Toxic Substances and Disease Registry (ATSDR), 1993. "Toxicological Profile for Acetone"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, February 1993.

United States Environmental Protection Agency. Integrated Risk Information System (IRIS), 1993.

__Ammonia__. Ammonia is a chemical that is both naturally occurring and man-made. It is composed of nitrogen and hydrogen. Man-made ammonia is used in fertilizers and manufacturing processes, and sometimes as a refrigerant. Ammonia is also used with chlorine to form chloramine, which is used to treat and disinfect drinking water. This treatment process also removes virtually all ammonia from drinking water.

Ammonia is produced endogenously in the body at a rate of approximately 4,200 mg/kg body weight/day. Ammonia is absorbed fairly completely in the gastrointestinal tract. Concentrated solutions of ammonia can cause burns to the skin if contacted, burns and ulceration of the gastrointestinal tract if swallowed, and irritation and burning in the lungs if vapors are inhaled. Ingestion of a 2.4% solution of ammonium hydroxide caused death in one adult male. Ammonia is not known to have any specific target organs; most adverse effects are associated with secondary effects, such as infection and weight loss, which are not directly attributable to exposures to ammonia. In general, these effects occur after exposure to high concentrations. The carcinogenic potential of ammonia has not been established in animals or humans.

The American Conference of Governmental Industrial Hygienists threshold limit value (for an 8-hour work-day) is 18 mg/m^3 in air. The lifetime drinking water health advisory for ammonia of 34 mg/L is based on the odor threshold for ammonia.

References:

Agency for Toxic Substances and Disease Registry (ATSDR), 1989. "Toxicological Profile for Ammonia (Draft)"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, October, 1989.

__Anthracene__. Anthracene is a member of the polycyclic aromatic hydrocarbon (PAH) class of compounds which contain two or more aromatic rings. PAHs are ubiquitous in nature and are also man-made. Like most PAHs, anthracene occurs naturally in coal tar, crude oil, and is formed from incomplete combustion of organic material. It is also a product of pyrolysis in tobacco smoke.

Toxicological data on anthracene are limited. Data on human exposures to anthracene suggest that it is a skin irritant. Epidemiological data of limited quality indicate that anthracene may produce skin and hematopoietic disorders in humans. Anthracene did not produce any adverse effects in a subchronic study on mice. No adequate data on the potential carcinogenicity of anthracene are available; however, this compound did not test positive in mutagenicity studies.

References:
MADEP, 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6"; Policy #WSC/ORS-142-92; Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, MA; September 1992.

__Benzo(a)anthracene__. Benzo(a)anthracene is a member of the polycyclic aromatic hydrocarbon (PAH) class of compounds, which contain two or more aromatic rings. PAHs are ubiquitous in nature and are also man-made. Benzo(a)anthracene occurs naturally in coal tar, crude oil, and is formed from incomplete combustion of organic material. It is also product of pyrolysis in tobacco smoke.

Benzo(a)anthracene has produced skin tumors in laboratory animals after dermal application. Benzo(a)anthracene produced mutations in bacteria and in mammalian cells, and transformed mammalian cells in culture. Although there are no human data that specifically link exposure to benzo(a)anthracene to human cancers, benzo(a)anthracene is a component of mixtures that have been associated with human cancer. As such, benzo(a)anthracene has been classified by USEPA as a B2, probable human carcinogen.

References:
MADEP, 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6"; Policy #WSC/ORS-142-92; Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, MA; September 1992.

__Benzo(a)pyrene__. Benzo(a)pyrene is a member of the polycyclic aromatic hydrocarbons (PAH) class of compounds which contain two or more aromatic rings. They are ubiquitous in nature and are also man made. Benzo(a)pyrene occurs naturally in coal tar, crude oil, and is formed from incomplete combustion of organic material. Human data demonstrating a causal relationship linking benzo(a)pyrene to carcinogenicity are lacking. However, multiple animal studies in many species demonstrate benzo(a)pyrene to be carcinogenic following administration by a variety of routes. The mechanism through which benzo(a)pyrene elicits its carcinogenic potential is well understood. Benzo(a)pyrene has produced positive results in numerous genotoxicity assays. Benzo(a)pyrene has been classified by the EPA as a B2, probable human carcinogen.

References:
ATSDR, 1989. Toxicological Profile for Polycyclic Aromatic Hydrocarbons. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, October, 1989.

Clayton, George D. and Florence E. Clayton, editors, 1981. Patty's Industrial Hygiene and Toxicology, 3rd Revised Edition; John Wiley & Sons; New York.

United States Environmental Protection Agency. Integrated Risk Information System (IRIS), 1993.

Benzo(b)fluoranthene. Benzo(b)fluoranthene is a member of the polycyclic aromatic hydrocarbon (PAH) class of compounds which contain two or more aromatic rings. PAHs are ubiquitous in nature and are also man-made. Benzo(b)fluoranthene occurs naturally in coal tar, crude oil, and is formed from incomplete combustion of organic material.

Although there are no human data that specifically link exposure to benzo(b)fluoranthene to human cancers, benzo(b)fluoranthene is a component of mixtures that have been associated with human cancer. These include coal tar, soots, coke oven emissions, and cigarette smoke. Benzo(b)fluoranthene produced tumors in mice after lung implantation, intraperitoneal, subcutaneous injection, and skin painting. Benzo(b)fluoranthene has produced positive results in several genotoxicity assays. It has been classified as a B2, probable human carcinogen, by the USEPA.

References:
MADEP, 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6"; Policy #WSC/ORS-142-92; Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, MA; September 1992.

Benzo(k)fluoranthene. Benzo(k)fluoranthene is a member of the polycyclic aromatic hydrocarbon (PAH) class of compounds, which contain two or more aromatic rings. PAHs are ubiquitous in nature and are also man-made. Benzo(k)fluoranthene occurs naturally in coal tar, crude oil, and is formed from incomplete combustion of organic material.

Although there are no human data that specifically link exposure to benzo(k)fluoranthene to human cancers, benzo(k)fluoranthene is a component of mixtures that have been associated with human cancer. These include coal tar, soots, coke oven emissions, and cigarette smoke. Benzo(k)fluoranthene produced tumors after lung implantation in mice and when administered with a promoting agent in skin-painting studies. Benzo(k)fluoranthene is mutagenic in bacteria. Benzo(k)fluoranthene has been classified by USEPA as a B2, probable human carcinogen.

References:
MADEP, 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6"; Policy #WSC/ORS-142-92; Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, MA; September 1992.

Benzo(g,h,i)perylene. Benzo(g,h,i)perylene is a member of the polycyclic aromatic hydrocarbon (PAH) class of compounds which contain two or more aromatic rings. PAHs are ubiquitous in nature and are also man-made. They occur naturally in coal tar, crude oil, and are formed from incomplete combustion of organic material.

There are no available data regarding human exposures. There are inadequate animal data from lung implant, skin-painting, and subcutaneous injection bioassays. The USEPA has determined that benzo(g,h,i)perylene is not classifiable as to human carcinogenicity, and has assigned it to class D.

References:

MADEP, 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6"; Policy #WSC/ORS-142-92; Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, MA; September 1992.

Bis(2-ethylhexyl)phthalate (DEHP). DEHP is used industrially as a plasticizer for resins and is found in many plastic materials, as it makes them more flexible. It is also used in manufacturing organic pump fluids in electrical capacitors. Acute exposure to DEHP has produced eye and mucous membrane irritation, nausea, and diarrhea. Studies of chronic exposure of laboratory animals to DEHP indicate that the target organs are the liver, where it causes morphological and biochemical changes, as well as the testes, where it produces damage to the seminiferous tubules. DEHP has produced developmental and reproductive effects in laboratory animals including spina bifida and reduced fertility. DEHP has been shown to cause a dose-related increase in liver tumors in mice and rats. Thus, the USEPA has designated DEHP as a B2, probable human carcinogen.

References:

ATSDR, 1991. Toxicological Profile for Di(2-ethylhexyl)phthalate. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, October, 1991.

Butylbenzylphthalate. Data on butylbenzylphthalate are limited. Laboratory animals orally exposed to butylbenzylphthalate for a chronic duration had decreased testicular and prostate weights, decreased levels of hemoglobin, and increased liver and brain to body weight ratios. Butylbenzylphthalate also produced leukemia in female rats. However, no carcinogenicity was observed in male rats or other laboratory animal species, and human epidemiological evidence is not available. Therefore, the USEPA has placed butylbenzylphthalate in weight of evidence group C, possible human carcinogen.

References:

United States Environmental Protection Agency. Integrated Risk Information System (IRIS), 1993.

Chlorobenzene. Chlorobenzene is used industrially as a solvent and in the manufacture of other chemicals. It is an intermediate in the manufacture of dyestuffs and pesticides. Acute exposures have caused irritation of the eyes, nose, and skin, as well as CNS depression accompanied by drowsiness, numbness, nausea, and vomiting. Evidence from animal studies indicates that exposure via ingestion or inhalation can produce severe kidney and liver effects. The USEPA has classified chlorobenzene in Group D, inadequate evidence of carcinogenicity.

References:

Clayton, George D. and Florence E. Clayton, editors, 1981. Patty's Industrial Hygiene and Toxicology, 3rd Revised Edition; John Wiley & Sons; New York.

United States Environmental Protection Agency. Integrated Risk Information System (IRIS), 1993.

Chromium. Chromium has been used in plating for corrosion resistance and decorative purposes, in the manufacture of alloys and chemicals, and in printing, dying, and photography. The toxicity of chromium depends upon its valence state. Hexavalent chromium is more toxic via inhalation than trivalent chromium. The effects of inhalation exposure to hexavalent chromium include ulcers of the upper respiratory tract, nasal inflammation, perforation of the nasal septa and lung cancer. There is epidemiological evidence of an association between chromium and lung cancer. Therefore, USEPA has classified hexavalent chromium as a Class A, human carcinogen, by the inhalation route. Most trivalent chromium compounds are inactive in short-term genotoxicity assays. Trivalent chromium compounds have not been found to be carcinogenic by any route of exposure. Exposure to trivalent chromium compounds is primarily associated with irritation of the skin or gastrointestinal tract, and inflammation of the liver.

References:

Amdur, Mary O., John Doull, Curtis D. Klaassen, 1991. Toxicology: The Basic Science of Poisons, 4th edition; Pergamon Press, Inc. New York.

United States Environmental Protection Agency. Integrated Risk Information System (IRIS), 1993.

Chrysene. Chrysene is one of the polycyclic aromatic hydrocarbon (PAH) compounds, which are formed during the combustion of organic material. Although there are no human data that specifically link exposure to chrysene to human cancers, chrysene is a component of mixtures that have been associated with human cancer. These include coal tar, soots, coke oven emissions, and cigarette smoke. Chrysene produced chromosomal abnormalities in hamsters and mouse germ cells after gavage exposure, produced positive responses in bacterial gene mutation assays, and transformed mammalian cells exposed in culture. Due to its similarity to benzo(a)pyrene and other carcinogenic PAHs, chrysene has been classified as a B2, probable human carcinogen.

References:

MADEP, 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6"; Policy #WSC/ORS-142-92; Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, MA; September 1992.

Dibenzo(a,h)anthracene. Dibenzo(a,h)anthracene is one of the polycyclic aromatic hydrocarbon (PAH) compounds, which are formed during the combustion of organic material. This compound is found in tobacco smoke, food, and industrial emissions. Although there are no human data that specifically link exposure to dibenzo(a,h)anthracene to human cancers, dibenzo(a,h)anthracene is a component of mixtures that have been associated with human cancer. These include coal tar, soots, coke oven emissions, and cigarette smoke. Dibenzo(a,h)anthracene is metabolized similarly to benzo(a)pyrene, and has produced skin tumors in laboratory animals following dermal exposure. Dibenzo(a,h)anthracene has also been shown to be mutagenic, producing DNA damage in human cell cultures. Due to its similarities with benzo(a)pyrene and other carcinogenic PAHs, dibenzo(a,h)anthracene has been classified as a B2, probable human carcinogen.

MADEP, 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6"; Policy #WSC/ORS-142-92; Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, MA; September 1992.

Di-n-butylphthalate. Di-n-butylphthalate is a man-made organic chemical that is used as a plasticizer for epoxy resins and polyvinyl chloride. These chemicals are, in turn, used in many commercial products, including food-packaging films. It is also used as a concrete additive, in insect repellents that are impregnated in clothing during manufacture, and as a solvent for perfume oils. Di-n-butylphthalate bioaccumulates in the food chain, and the majority of the population that is exposed to di-n-butylphthalate is likely exposed throughout this medium.

No data regarding the exposure of humans to di-n-butylphthalate are available. Animal studies suggest that di-n-butylphthalate may target the reproductive system. Di-n-butylphthalate produced degeneration of the seminiferous tubules and decreased sperm count, and decreased litter size accompanied with increased fetal death rate, in orally-exposed male and female animals, respectively. Like other phthalate compounds, di-n-butylphthalate has the ability to induce peroxisome proliferation, which has been associated with increased cancer risk. However, limited animal studies suggest that di-n-butylphthalate is not a carcinogen in animals.

References:

Agency for Toxic Substances and Disease Registry (ATSDR), 1989. "Toxicological Profile for Di-n-butylphthalate"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, October 1989.

Di-n-octylphthalate. Data for di-n-octylphthalate are extremely limited. However, based on its similar structure to di-n-butylphthalate, di-n-octylphthalate likely possess similar chemical, physical, and toxicological properties. (See profile for di-n-butylphthalate above.)

Fluoranthene. Fluoranthene is one of the polycyclic aromatic hydrocarbon (PAH) compounds, which are formed during the combustion of organic material. Although there are no human data that specifically link exposure to fluoranthene to human cancers, fluoranthene is a component of mixtures that have been associated with human cancer. It is a constituent of coal tar and petroleum-derived asphalt. No data regarding human exposure are available, and animal data suggest that fluoranthene is not carcinogenic. Fluoranthene has been classified by the USEPA as a D carcinogen.

References:

ATSDR, 1989. Toxicological Profile for Polycyclic Aromatic Hydrocarbons. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, October, 1989.

Fluorene. Fluorene is a member of the polycyclic aromatic hydrocarbon (PAH) class of compounds, which contain two or more aromatic rings. PAHs are ubiquitous in nature and are also man-made. Similar to many PAHs, fluorene occurs naturally in coal tar, crude oil, and is formed from incomplete combustion of organic material.

Toxicological data on fluorene as a single compound are limited. Laboratory animals orally exposed to fluorene exhibited hypoactivity, decreased red blood cell count, and increased liver, spleen, and kidney weights. Limited animal data suggest that fluorene may be capable of causing proliferative cellular changes. However, fluorene was not mutagenic in limited genotoxicity studies, and was not considered a tumor promotor in mice.

References:
MADEP, 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6"; Policy #WSC/ORS-142-92; Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, MA; September 1992.

2-Hexanone. 2-Hexanone is a naturally occurring compound that has been detected in blue cheese, nectarines, raw chicken breasts, and poultry manure. In industry, 2-hexanone is used as a medium-evaporating solvent for nitrocellulose, acrylates, vinyl and alkyl coatings. Exposure of the general population may occur through in the ingestion of natural or processed foods, where the compound occurs naturally and through inhalation of vapors from commercial coatings. In humans, acute inhalation exposure caused irritation to the eyes and nose. .Neurotoxic effects, characterized by the development of peripheral neuropathy, were seen following subchronic exposure to 2-hexanone. Testicular atrophy was observed in rats following a ten-week oral exposure. Methyl ethyl ketone can potentiate the neurotoxicity of methyl butyl ketone. The USEPA has classified 2-hexanone as a class D carcinogen, not classifiable regarding carcinogenicity.

References:
USEPA, 1990. Health and Environmental Effects Document for 2-Hexanone - Draft. Prepared by: Environmental Criteria and Assessment Office.

United States Environmental Protection Agency. Integrated Risk Information System (IRIS), 1993.

Indeno(1,2,3-cd)pyrene. Indeno(1,2,3-c,d)pyrene is one of the polycyclic aromatic hydrocarbon (PAH) compounds, which are formed during the combustion of organic material, and is a component of cigarette smoke and smoke-stack emissions. No carcinogenicity data specifically for indeno(1,2,3-c,d)pyrene are available in humans; however, toxic effects are attributable to mixtures of PAHs. Animal studies indicate that indeno(1,2,3-c,d)pyrene can induce skin tumors in mice, and may have some immunosuppressive effects. In mammalian cell cultures, indeno(1,2,3-c,d)pyrene was found to be genotoxic. It has been classified by the USEPA as a B2 carcinogen.

References:

MADEP, 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6"; Policy #WSC/ORS-142-92; Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, MA; September 1992.

Iron. Iron is a metal which is required for a variety of physiological functions such as heme biosynthesis, oxidative phosphorylation and mixed-function oxidase-mediated metabolic reactions. Only divalent forms of iron are absorbed. As absorption occurs, divalent iron is biochemically converted to trivalent iron, the biologically active form. Under normal conditions, absorbed dietary iron is complexed to hemoglobin and transported to the liver for storage until needed for physiological reactions. The balance of iron is regulated only by the amount of dietary intake and the degree of intestinal absorption. Intestinal absorption tends to be low (2 - 15%) except during periods of increased iron need when absorption efficiency increases dramatically.

Acute iron toxicity has been well characterized following the accidental ingestion of iron-containing preparations by children. Shortly after ingestion, the corrosive effects of iron cause vomiting and diarrhea, often bloody. Later signs include shock, metabolic acidosis, seizures, liver and/or kidney failure, coma, and death. Chronic iron overload manifests as disturbances in liver function, diabetes mellitus, and endocrine and cardiovascular effects. Inhalation of iron-containing dust or fumes in occupational settings may result in deposition of iron particles in the lungs, leading to interstitial fibrosis. Autopsies of hematite miners noted an increase in lung cancer. However, the etiology of the lung cancer may be related to factors other than iron exposure such as cigarette, silica, or PAH exposures.

References:

Aisen, P., Cohen, G. and Kang, J.O., 1990. Iron Toxicosis. Int. Rev. Exp. Pathol. 31:1-46.

Goyer, R.A., 1991. Toxic Effects of Metals. In: Casarett and Doull's Toxicology: The Basic Science of Poisons, 3rd edition. Eds. C.D. Klaassen, M.O. Amdur and J. Doull. Macmillan Publishing Co. N.Y.

Manganese. Manganese is a naturally occurring substance found in many types of rock. It does not generally occur in the environment as the pure metal; rather, it is found combined with other chemicals such as sulfur, oxygen, and chlorine. Manganese is mixed with iron to make various types of steel. Manganese is a component of some ceramics, pesticides, fertilizers, and in nutritional supplements. In small doses, manganese is beneficial to human health. Manganese miners and steel workers exposed to elevated concentrations of manganese have evidenced mental and emotional disturbances, and slow and clumsy body movements. Target organs of manganese are the lung and CNS. When inhaled, manganese dust can also cause lung irritation. The USEPA has classified manganese as a Class D, not classifiable as to human carcinogenicity.

References:

Agency for Toxic Substances and Disease Registry (ATSDR), 1991. "Toxicological Profile for Manganese"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, February 1991.

2-Methylnaphthalene. 2-Methylnaphthalene is a member of the polycyclic aromatic hydrocarbon (PAH) class of organic compounds, and is used in the synthesis of chemicals such as insecticides. Toxicological data on 2-methylnaphthalene are extremely limited. However, based on its structural similarity to naphthalene, it is likely to be metabolized through a similar process, and therefore is expected to exert effects similar to those induced by naphthalene. (See profile for naphthalene below.)

References:

ATSDR, 1989. Toxicological Profile for Naphthalene and 2-Methylnaphthalene. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, October, 1989.

2- and 4-Methylphenol. 2- Methylphenol and 4-methylphenol, also called o-cresol and p-cresol, are both naturally occurring and synthetically produced organic chemicals containing a single aromatic ring. m-Cresol is another isomer of 2- and 4-methylphenol. 2- and 4-Methylphenol are often found together in mixtures, such as in disinfectants. Specific uses of 2-methylphenol include resins and pharmaceuticals. 4-Methylphenol is used in industry in the manufacture of antioxidants and in the manufacture of perfumes and dyes. 4-Methylphenol is also used in synthetic food flavors.

2- and 4-Methylphenol exhibit similar toxicities. They are highly irritating to the skin when contacted dermally, the lungs when inhaled, and the gastrointestinal tract when ingested, and can be readily absorbed by all three exposure routes. Neurological effects, including lethargy, incoordination, tremors, convulsions, and coma have been observed in humans who have been exposed to high concentrations of cresols. These effects have also been observed in laboratory animals, and can also result from long-term low-level exposure to cresols. There is no evidence of reproductive, developmental, or carcinogenic effects in humans or animals following exposure to cresols.

References:
Agency for Toxic Substances and Disease Registry (ATSDR), 1990. "Toxicological Profile for Cresols"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service. October, 1990.

Naphthalene. Naphthalene is a member of the polycyclic aromatic hydrocarbon (PAH) class of compounds, which contain two or more aromatic rings. PAHs are ubiquitous in nature and are also man-made. Naphthalene occurs naturally in coal tar, crude oil, and is formed from incomplete combustion of organic material. It is also product of pyrolysis in tobacco smoke. Naphthalene is used for the production of phthalic anhydride, which is used for the production of plasticizers. Naphthalene is also used in moth balls, for the production of the insecticide carbaryl, and in numerous resins, dyes, pharmaceuticals, and other organic materials.

Naphthalene is absorbed through the inhalation, oral, and dermal routes, and appears to be more toxic to humans than laboratory animals. The principal toxic effect of naphthalene in humans and animals is hemolysis of red blood cells, which can lead to anemia, decreased oxygen-carrying capacity, and jaundice. Humans pre-disposed to anemia, such as those with G6DP enzyme deficiency, may be particularly sensitive to naphthalene toxicity. Exposure to naphthalene has also been correlated with increased risk of cataract formation. Animal studies were negative for naphthalene reproductive toxicity. Although no human epidemiological data are available for assessing naphthalene carcinogenicity, animal data investigating naphthalene toxicity are equivocal. The USEPA has placed naphthalene in weight-of-evidence Group D, not classifiable as to human carcinogenicity.

References:
Agency for Toxic Substances and Disease Registry (ATSDR), 1990. "Toxicological Profile for Naphthalene"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service. October, 1990.

N-Nitrosodiphenylamine and N-Nitrosodi-n-propylamine. N-Nitrosodiphenylamine (NNDPA) and N-Nitrosodi-n-propylamine (NNDNPA) are man-made chemicals that were historically used in the rubber manufacturing process. However, production of these chemicals and import to the US ceased in the early 1980's because they were replaced by improved chemicals. Toxicological data on NNDPA and NNDNPA are limited. The majority of data come from a few studies conducted with laboratory animals. The results of these studies suggest that these chemicals are absorbed from the GI tract. The liver, kidney, and eyes, and bladder appear to be the primary target organs for these chemicals.

For NNDPA, effects to the liver, kidney and eyes only occurred at high dose levels, suggesting that NNDPA is associated with a low order of toxicity. Notably, these effects did not occur under lower-dose, chronic exposures.

Under chronic exposures, NNDPA produced bladder toxicity in mice and rats, and bladder cancer in rats. Based on this evidence of potential carcinogenicity in one species of laboratory animal, USEPA has classified NNDPA as a group B2, possible carcinogen.

For NNDNPA, the primary target organ is the liver. Acute and subchronic exposures to NNDNPA have produced hepatotoxicity, as well as hemorrhagic lesions on other internal organs. NNDNPA has been shown to produce tumors, primarily in the liver, in several animal species. NNDNPA has tested positive in genotoxicity assays, and is suspected of being a direct-acting mutagen. No data are available regarding the potential carcinogenicity of NNDNPA in humans. USEPA has classified NNDPA as a group B2, possible carcinogen.

References:

Agency for Toxic Substances and Disease Registry (ATSDR), 1987. "Toxicological Profile for N-Nitrosodiphenylamine (Draft)"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service. October, 1987.

Agency for Toxic Substances and Disease Registry (ATSDR), 1990. "Toxicological Profile for N-Nitrosodi-n-propylamine (Draft)"; Agency for Toxic Substances and Disease Registry, U.S. Public Health Service. December, 1988.

Nitrate and Nitrite. Nitrate (NO_3) and nitrite (NO_2) are naturally occurring ions that are part of the nitrogen cycle. They are produced from the natural decomposition of organic matter (e.g., livestock waste, urban sewage, compost), and are also present at high concentrations in commercial fertilizers. Nitrates and nitrites are also present naturally in some vegetables, and are added as sodium nitrate and sodium nitrite as a preservative to some meats.

Nitrates and nitrites are rapidly and completely absorbed in the gastrointestinal tract. Once absorbed, nitrates are converted to nitrites. Nitrites (and nitrates to a lesser extent) can oxidize iron in blood hemoglobin. This interaction causes methemoglobinemia, which is the primary toxic effect associated with nitrate and nitrite exposure. Methemoglobinemia results in an inability for blood hemoglobin to carry oxygen. This can result in cyanosis, cardiac arrythmias, and effects on the central nervous system. Infants under 4 months old and people with congenital methemoglobinemia are particularly sensitive to the effects of nitrate and nitrite because their bodies cannot detoxify nitrates and nitrites as efficiently. Methemoglobinemia is reversible, and will naturally dissipate when exposures to nitrates and nitrites are decreased. Nitrates and nitrites have not been shown to produce cancer in laboratory animals or humans. However, when nitrates and nitrites react with certain other chemicals, nitrosamines may be produced, which have been reported to cause cancer in laboratory animals.

References:

Agency for Toxic Substances and Disease Registry (ATSDR), 1991. "Case Studies in Environmental Medicine, Nitrate/Nitrite Toxicity" Agency for Toxic Substances and Disease Registry, U.S. Public Health Service. October, 1991.

Phenanthrene. Phenanthrene is a member of the polycyclic aromatic hydrocarbon (PAH) class of compounds, which contain two or more aromatic rings. PAHs are ubiquitous in nature and are also man-made. Phenanthrene occurs naturally in coal tar, crude oil, and is formed from incomplete combustion of organic material.

Phenanthrene has been shown to be a skin photosensitizer in humans. Intraperitoneally injection in rats produced liver effects. Although limited evidence exists that phenanthrene is a mutagen, the majority of tests have proved negative. Equivocal evidence exists for cancer after dermal application of phenanthrene in rats. Ingestion of 200 mg of phenanthrene produced no tumors in rats after two months.

References:

MADEP, 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6"; Policy #WSC/ORS-142-92; Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, MA; September 1992.

<u>**Phenol**</u>. Phenol is a man-made aromatic chemical that is used extensively in the production of numerous products, including a wide variety of aromatic compounds, explosives, fertilizers, paints, rubber, plastic, and textiles.

Phenol is readily absorbed through ingestion, dermal, and inhalation exposures, and is rapidly distributed to tissues. Exposure to phenol can produce adverse effects on the central nervous system, including loss of consciousness and acute respiratory failure. Phenol can also cause severe burning of the mouth and throat if swallowed. Current genotoxicity and cancer studies on phenol are inadequate or inconclusive to allow a determination of the potential carcinogenicity of this chemical at this time.

References:

MADEP, 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6"; Policy #WSC/ORS-142-92; Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, MA; September 1992.

<u>**Pyrene**</u>. Pyrene is a member of the polycyclic aromatic hydrocarbon (PAH) class of compounds which contain two or more aromatic rings. They are ubiquitous in nature and are also man-made. Pyrene occurs naturally in coal tar, crude oil, and is formed from incomplete combustion of organic material. Pyrene is reported to be a skin irritant to humans. Rats administered pyrene exhibited blood chemistry changes, as well as liver and kidney damage. Pyrene was shown to be inactive as an initiating agent and thus has been classified by the USEPA as a D carcinogen.

References:

ATSDR, 1989. Toxicological Profile for Polycyclic Aromatic Hydrocarbons. Agency for Toxic Substances and Disease Registry, U.S. Public Health Service, October, 1989.

<u>**Sulfate**</u>. Sulfate is a naturally occurring ion in soil and water. It is also used in some chemical manufacturing processes, and is produced as a by-product to other industrial processes. The available toxicological information for sulfate is limited. However, sulfate has been associated with laxative effects. Exposure to high concentrations has caused nausea and diarrhea in some people. A primary drinking water MCL of 500 mg/L has been proposed (but not adopted) based on the laxative effects of sulfate.

TABLE A4-1
ORAL DOSE-RESPONSE DATA
FOR CARCINOGENIC EFFECTS

Olin Corporation
Wilmington, MA Facility

Compound	Chemical Group	Weight of Evidence	Oral Slope Factor $(mg/kg/day)^{-1}$	Test Species	Study Type	Tumor Type	Source
ACID EXTRACTABLE COMPOUNDS							
2,4,6-Trichlorophenol	A	B2	1.1E-02	Rat	Oral-diet	Leukemia	IRIS
2,4-Dichlorophenol	A	ND					
2,4-Dimethylphenol	A	ND					
2,4-Dinitrophenol	A	ND					
2-Chlorophenol	A	ND					
2-Methylphenol (o-Cresol)	A	C	ND				IRIS
2-Nitrophenol	A	ND					
4,6-Dinitro-2-methylphenol	A	ND					
4-Chloro-3-methylphenol	A	ND					
4-Methylphenol (p-Cresol)	A	C	ND				IRIS
4-Nitrophenol	A	ND					
Benzoic Acid	A	D					IRIS
Phenol	A	D					IRIS
BASE NEUTRAL COMPOUNDS							
1,2,3-Trichlorobenzene	B	ND					
1,2,4-Trichlorobenzene	B	D					IRIS
1,2-Dichlorobenzene	B	D					IRIS
1,3-Dichlorobenzene	B	D					IRIS
1,4-Dichlorobenzene	B, V	C	2.4E-02	Mouse	Oral-gavage	Liver	HEAST
2,6-Dintrotoluene	B	B2	6.8E-01 +	Rat	Oral-diet	Liver, mammary gland	IRIS
2-Methylnaphthalene	B	ND					
4-Bromophenyl-phenylether	B	ND					
4-Chloroaniline	B	ND					
4-Chlorophenyl-phenylether	B	ND					
4-Nitroaniline	B	ND					
Acenaphthene	B	ND					
Acenaphthylene	B	D					IRIS
Anthracene	B	D					IRIS
Benzo(a)anthracene	B	B2	7.3E-01 **				IRIS
Benzo(a)pyrene	B	B2	7.3E+00	Mouse	Oral-diet	Forestomach	IRIS

TABLE A4-1
ORAL DOSE-RESPONSE DATA
FOR CARCINOGENIC EFFECTS

Olin Corporation
Wilmington, MA Facility

Compound	Chemical Group	Weight of Evidence	Oral Slope Factor $(mg/kg/day)^{-1}$	Test Species	Study Type	Tumor Type	Source
Benzo(b)fluoranthene	B	B2	7.3E-01 **				IRIS
Benzo(g,h,i)perylene	B	D					IRIS
Benzo(k)fluoranthene	B	B2	7.3E-02 **				IRIS
Benzyl Alcohol	B	ND					
Bis(2-ethylhexyl)phthalate (BEHP)	B	B2	1.4E-02	Mouse	Oral-diet	Liver	IRIS
Bis(Chloromethyl)ether	B	B2	1.1E+00	Mouse	Oral-Diet	Liver	IRIS
Butylbenzylphthalate	B	C	ND				IRIS
Chrysene	B	B2	7.3E-03 **				IRIS
Di-n-butylphthalate	B	D					IRIS
Di-n-octylphthalate	B	ND					
Dibenzo(a,h)anthracene	B	B2	7.3E+00 **				IRIS
Dibenzofuran	B	D					IRIS
Diethylphthalate	B	D					IRIS
Dimethylphthalate	B	D					IRIS
Fluoranthene	B	D					IRIS
Fluorene	B	D					IRIS
Hexachlorobenzene	B	B2	1.6E+00	Rat	Oral-diet	Liver	IRIS
Indeno(1,2,3-cd)pyrene	B	B2	7.3E-01 **				IRIS
Isophorone	B	C	9.5E-04	Rat	Oral-gavage	Kidney	IRIS
n-Nitrosodi-n-propylamine	B	B2	7.0E+00	Rat	Oral-DW	Liver	IRIS
n-Nitrosodiphenylamine	B	B2	4.9E-03	Rat	Oral-DW	Bladder	IRIS
Naphthalene	B, V	D					IRIS
Nitrobenzene	B	ND					
Phenanthrene	B	D					IRIS
Pyrene	B	D					IRIS
INORGANICS/METALS							
Aluminum	I/M	ND					
Antimony	I/M	ND					
Arsenic	I/M	A	1.5E+00	Human	Oral-DW	Skin	IRIS
Barium	I/M	ND					
Beryllium	I/M	B2	4.3E+00	Rat	Oral-DW	Total	IRIS

TABLE A4-1
ORAL DOSE-RESPONSE DATA
FOR CARCINOGENIC EFFECTS

Olin Corporation
Wilmington, MA Facility

Compound	Chemical Group	Weight of Evidence	Oral Slope Factor (mg/kg/day)[1]	Test Species	Study Type	Tumor Type	Source
Cadmium	I/M	B1	ND				IRIS
Calcium	I/M	ND					
Chloride	I/M	ND					
Chromium III	I/M	ND					
Chromium VI	I/M	ND					
Cobalt	I/M	ND					
Copper	I/M	D					IRIS
Cyanide	I/M	D					IRIS
Iron	I/M	ND					
Lead	I/M	B2	ND				IRIS
Magnesium	I/M	ND					
Manganese	I/M	D					IRIS
Mercury (as mercuric chloride)	I/M	D					IRIS
Nickel	I/M	ND					
Nitrate	I/M	ND					
Nitrite	I/M	ND					
Nitrogen, Ammonia	I/M	ND					
Potassium	I/M	ND					
Selenium	I/M	D					IRIS
Silver	I/M	D					IRIS
Sodium	I/M	ND					
Strontium	I/M	ND					
Sulfates as SO_4	I/M	ND					
Sulfide	I/M	ND					
Thallium	I/M	ND					
Vanadium	I/M	ND					
Zinc	I/M	D					IRIS
PESTICIDES/PCBs							
4,4'-DDD	P	B2	2.4E-01	Mouse	Oral-diet	Liver	IRIS
4,4'-DDE	P	B2	3.4E-01	Mouse/hamster	Oral-diet	Liver	IRIS
4,4'-DDT	P	B2	3.4E-01	Mouse/rat	Oral-diet	Liver	IRIS

TABLE A4-1
ORAL DOSE-RESPONSE DATA
FOR CARCINOGENIC EFFECTS

Olin Corporation
Wilmington, MA Facility

Compound	Chemical Group	Weight of Evidence	Oral Slope Factor (mg/kg/day)-1		Test Species	Study Type	Tumor Type	Source
Aldrin	P	B2	1.7E+01		Mouse	Oral-diet	Liver	IRIS
alpha-BHC	P	B2	6.3E+00		Mouse/rat	Oral-diet	Liver	IRIS
Aroclor-1016	P	See PCBs						IRIS
beta-BHC	P	C	1.8E+00		Mouse	Oral-diet	Liver	IRIS
Chlordane (alpha & gamma isomers)	P	B2	1.3E+00	*	Mouse	Oral-diet	Liver	IRIS
delta-BHC	P	D						IRIS
Dieldrin	P	B2	1.6E+01		Mouse	Oral-diet	Liver	IRIS
Endosulfan I	P	ND						
Endosulfan II	P	ND						
Endosulfan Sulfate	P	ND						
Endrin	P	D						IRIS
Endrin aldehyde	P	ND						
Endrin ketone	P	ND						
Heptachlor	P	B2	4.5E+00		Mouse	Oral-diet	Liver	IRIS
Heptachlor Epoxide	P	B2	9.1E+00		Mouse	Oral-diet	Liver	IRIS
Lindane (gamma-BHC)	P	B2-C	1.3E+00		Mouse	Oral-diet	Liver	HEAST
Methoxychlor	P	D						IRIS
Polychlorinated Biphenyls (PCBs)	P	B2	See Below	***	Rat	Oral-diet	Liver	IRIS
high risk and persistence-central estimate	P		1.0E+00					
high risk and persistence-upper bound	P		2.0E+00					
low risk and persistence-central estimate	P		3.0E-01					
low risk and persistence-upper bound	P		4.0E-01					
lowest risk and persistence-central estimate	P		4.0E-02					
lowest risk and persistence-upper bound	P		7.0E-02					
Toxaphene	P	B2	1.1E+00		Mouse	Oral-diet	Liver	IRIS
VOLATILES								
1,1,1-Trichloroethane	V	D						IRIS
1,1,2,2-Tetrachloroethane	V	C	2.0E-01		Mouse	Oral-gavage	Liver	IRIS
1,1,2-Trichloroethane	V	C	5.7E-02		Mouse	Oral-gavage	Liver	IRIS
1,1-Dichloroethane	V	C	5.7E-03		Rat	Oral-gavage	Mammary Gland	CA EPA
1,1-Dichloroethene	V	C	6.0E-01		Rat	Oral-DW	Adrenal	IRIS

TABLE A4-1
ORAL DOSE-RESPONSE DATA
FOR CARCINOGENIC EFFECTS

Olin Corporation
Wilmington, MA Facility

Compound	Chemical Group	Weight of Evidence	Oral Slope Factor $(mg/kg/day)^{-1}$	Test Species	Study Type	Tumor Type	Source
1,2-Dichloroethane	V	B2	9.1E-02	Rat	Oral-gavage	Hemangiosarcomas	IRIS
1,2-Dichloroethene (total)	V	ND					
1,2-Dichloroethene (cis)	V	D					IRIS
1,2-Dichloroethene (trans)	V	ND					
1,2-Dichloropropane	V	B2	6.8E-02	Mouse	Oral-gavage	Liver	HEAST
1,3,5-Trimethylbenzene	V	ND					
2,4,4-Trimethyl-1-pentene	V	ND					
2,4,4-Trimethyl-2-pentene	V	ND					
2-Butanone (Methyl ethyl ketone)	W	D					IRIS
2-Hexanone	V	ND					
4-Methyl-2-pentanone (MIBK)	V	ND					
Acetone	V	D					IRIS
Benzene	V	A	2.9E-02	Human	Occupational	Leukemia	IRIS
Bromodichloromethane	V	B2	6.2E-02	Mouse	Oral-gavage	Kidney	IRIS
Bromoform	V	B2	7.9E-03	Rat	Oral-gavage	Large Intestine	IRIS
Carbon Disulfide	V	ND					
Carbon Tetrachloride	V	B2	1.3E-01	Several	Oral-gavage	Liver	IRIS
Chlorobenzene	V	D					IRIS
Chloroform	V	B2	6.1E-03	Rat	Oral-DW	Kidney	IRIS
Chloromethane	V	C	1.3E-02	Mouse	Inhalation	Kidney	HEAST
Dibromochloromethane	V	C	8.4E-02	Mouse	Oral-gavage	Liver	IRIS
Ethyl chloride (Chloroethane)	V	ND					
Ethylbenzene	V	D					IRIS
Hexachlorobutadiene	V	C	7.8E-02	Rat	Oral-diet	Kidney	IRIS
Methylene Chloride (Dichloromethane)	V	B2	7.5E-03	Mouse	Oral-DW	Liver	IRIS
Styrene	V	ND					
Tetrachloroethene	V	B2	5.1E-02 W	Mouse	Oral-gavage	Liver	CAEPA
Toluene	V	D					IRIS
Trichloroethene	V	B2	1.5E-02 W	Mouse	Oral-gavage	Liver	CAEPA
Vinyl Acetate	V	ND					
Vinyl Chloride	V	A	1.9E+00	Rat	Oral-diet	Lung, liver	HEAST
Xylenes (total)	V	D					IRIS

TABLE A4-1
ORAL DOSE-RESPONSE DATA
FOR CARCINOGENIC EFFECTS

Olin Corporation
Wilmington, MA Facility

Compound	Chemical Group	Weight of Evidence	Oral Slope Factor (mg/kg/day)$^{-1}$	Test Species	Study Type	Tumor Type	Source

NOTES:

ND - Not determined/No data
W - Withdrawn from IRIS/HEAST
DW - Drinking water
mg - milligram
kg - kilogram
IRIS - Integrated Risk Information System
HEAST - Health Effects Assessment Summary Tables
MADEP - Massachusetts Department of Environmental Protection
"Background Documentation for the Development of the MCP Numerical Standards" April, 1994
CA EPA - California Environmental Protection Agency
"California Environmental Protection Agency Criteria for Carcinogens" November, 1994

\+ - Based on IRIS for 2,4-; 2,6-Dinitrotoluene mixture
* - The value for chlordane is used as surrogate for the isomers.
** - Slope Factor for Benzo(a)Pyrene used for other carcinogenic PAHs, adjusted by Relative Potency Factors of 1.0 [benzo(a)pyrene, dibenz(a,h)anthracene]; 0.1 [benzo(a)anthracene, benzo(b)flouoranthene, indeno(1,2,3-c,d)pyrene]; 0.01 [benzo(k)fluoranthene]; 0.001 [chrysene].
*** Slope factors are applicable to Aroclors 1016, 1248, 1254, and 1260.

Chemical Groups:
A - Acid extractable
B - Base neutral extractable
I/M - Inorganic/Metal
P - Pesticide
V - Volatile
W - Waste

Weight of Evidence (Route-Specific):
A - Human carcinogen
B - Probable human carcinogen
B1 - limited evidence of cancer in humans
B2 - sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans
C - Possible human carcinogen
D - Not classifiable as to human carcinogenicty
E - Evidence of lack of carcinogenicity to humans

Sources (in order used, per MADEP, 1995):
IRIS as of 1/97
HEAST, 1995 (including July updates)
CA EPA, 1994
MADEP, 1994

TABLE A4-2
INHALATION DOSE-RESPONSE DATA
FOR CARCINOGENIC EFFECTS

Olin Corporation
Wilmington, MA Facility

Compound	Chemical Group	Weight of Evidence	Inhalation Slope Factor* $(mg/kg/day)^{-1}$	Unit Risk* $(ug/m^3)^{-1}$	Test Species	Study Type	Tumor Type	Source
ACID EXTRACTABLE COMPOUNDS								
2,4,6-Trichlorophenol	A	B2	1.0E-02	3.1E-06	Rat	Oral-diet	Leukemia	IRIS
2,4-Dichlorophenol	A	ND						
2,4-Dimethylphenol	A	ND						
2,4-Dinitrophenol	A	ND						
2-Chlorophenol	A	ND						
2-Methylphenol (o-cresol)	A	C	ND	ND				IRIS
2-Nitrophenol	A	D						IRIS
4,6-Dinitro-2-methylphenol	A	D						IRIS
4-Chloro-3-methylphenol	A	D						IRIS
4-Methylphenol (p-Cresol)	A	C	ND	ND				
4-Nitrophenol	A	ND						
Benzoic Acid	A	D						IRIS
Phenol	A	D						IRIS
BASE NEUTRAL COMPOUNDS								
1,2,3-Trichlorobenzene	B	ND						
1,2,4-Trichlorobenzene	B	D						
1,2-Dichlorobenzene	B	D						IRIS
1,3-Dichlorobenzene	B	D						IRIS
1,4-Dichlorobenzene	B, V	C	4.0E-02	1.1E-05	Mouse	Oral-gavage	Liver	CA EPA
2,6-Dinitrotoluene	B	B2	ND	ND				IRIS
2-Methylnaphthalene	B	ND						
4-Bromophenyl-phenylether	B	D						IRIS
4-Chloroaniline	B	ND						
4-Chlorophenyl-phenylether	B	D						IRIS
4-Nitroaniline	B	ND						
Acenaphthene	B	ND						
Acenaphthylene	B	D						IRIS
Anthracene	B	D						IRIS
Benzo(a)anthracene	B	B2	3.9E-01 **	1.1E-04 **				CA EPA
Benzo(a)pyrene	B	B2	3.9E+00	1.1E-03	Hamster	Inhalation	Respiratory tract	CA EPA
Benzo(b)fluoranthene	B	B2	3.9E-01 **	1.1E-04 **				CA EPA
Benzo(g,h,i)perylene	B	D						IRIS
Benzo(k)fluoranthene	B	B2	3.9E-02 **	1.1E-05 **	Hamster	Inhalation	Respiratory tract	CA EPA
Benzyl Alcohol	B	ND						IRIS
bis(2-ethylhexyl)phthalate (BEHP)	B	B2	8.4E-03	2.4E-06	Mouse	Oral-Diet	Liver	CAEPA
bis(Chloromethyl)ether	B	B2		3.3E-04	Mouse	Oral-Diet	Liver	IRIS
Butylbenzylphthalate	B	C	ND	ND				IRIS
Chrysene	B	B2	3.9E-03 **	1.1E-06 **				CA EPA

TABLE A4-2
INHALATION DOSE-RESPONSE DATA
FOR CARCINOGENIC EFFECTS

Olin Corporation
Wilmington, MA Facility

Compound	Chemical Group	Weight of Evidence	Inhalation Slope Factor* $(mg/kg/day)^{-1}$	Unit Risk $(ug/m^3)^{-1}$	Test Species	Study Type	Tumor Type	Source
Di-n-butylphthalate	B	D						IRIS
Di-n-octylphthalate	B	ND						
Dibenzo(a,h)anthracene	B	B2	4.1E+00	1.2E-03	Mouse	Oral-DW	Lung	CA EPA
Dibenzofuran	B	D						IRIS
Diethylphthalate	B	D						IRIS
Dimethylphthalate	B	D						IRIS
Fluoranthene	B	D						IRIS
Fluorene	B	D						IRIS
Hexachlorobenzene	B	B2	1.6E+00	4.6E-04	Rat	Oral-diet	Liver	IRIS
Indeno(1,2,3-cd)pyrene	B	B2	3.9E-01 **	1.1E-04 **				CA EPA
Isophorone	B	ND						
n-Nitrosodi-n-propylamine	B	B2	7.0E+00	2.0E-03	ND	ND	ND	CA EPA
n-Nitrosodiphenylamine	B	B2	9.0E-03	2.6E-06	ND	ND	ND	CA EPA
Naphthalene	B, V	D						IRIS
Nitrobenzene	B	D						IRIS
Phenanthrene	B	D						IRIS
Pyrene	B	D						IRIS
INORGANICS/METALS								
Aluminum	I/M	ND						
Antimony	I/M	ND						
Arsenic	I/M	A	1.5E+01	4.3E-03	Human	Inhalation	Lung	IRIS
Barium	I/M	ND						
Beryllium	I/M	B2	8.4E+00	2.4E-03	Human	Inhalation	Lung	IRIS
Cadmium	I/M	B1	6.3E+00 c	1.8E-03	Human	Inhalation	Lung	IRIS
Calcium	I/M	ND						
Chloride	I/M	ND						
Chromium III	I/M	ND						
Chromium VI	I/M	A	4.1E+01	1.2E-02	Human	Inhalation	Lung	IRIS
Cobalt	I/M	ND						
Copper	I/M	D						IRIS
Cyanide	I/M	D						IRIS
Iron	I/M	ND						
Lead	I/M	B2	ND	ND				IRIS
Magnesium	I/M	ND						
Manganese	I/M	D						IRIS
Mercury (as mercuric chloride)	I/M	D						IRIS
Nickel	I/M	A	8.4E-01	2.4E-04	Human	Inhalation	Lung	IRIS
Nitrate	I/M	ND						
Nitrite	I/M	ND						

TABLE A4-2
INHALATION DOSE-RESPONSE DATA
FOR CARCINOGENIC EFFECTS

Olin Corporation
Wilmington, MA Facility

Compound	Chemical Group	Weight of Evidence	Inhalation Slope Factor* $(mg/kg/day)^{-1}$	Unit Risk $(\mu g/m^3)^{-1}$	Test Species	Study Type	Tumor Type	Source
Nitrogen, Ammonia	I/M	ND						
Potassium	I/M	ND						
Selenium	I/M	D						IRIS
Silver	I/M	D						IRIS
Sodium	I/M	ND						
Strontium	I/M	ND						
Sulfates as SO_4	I/M	ND						
Sulfide	I/M	ND						
Thallium	I/M	ND						
Vanadium	I/M	ND						
Zinc	I/M	D						IRIS
PESTICIDES/PCBs								
4,4'-DDD	P	B2	3.4E-01	9.7E-05	Mouse	Oral-diet	Liver	IRIS
4,4'-DDE	P	B2	3.4E-01	9.7E-05	Mouse	Oral-diet	Liver	IRIS
4,4'-DDT	P	B2	3.4E-01	9.7E-05	Mouse	Oral-diet	Liver	IRIS
Aldrin	P	B2	1.7E+01	4.9E-03	Mouse	Oral-diet	Liver	IRIS
alpha-BHC	P	B2	6.3E+00	1.8E-03	Mouse	Oral-diet	Liver	IRIS
Aroclor 1016	P	See PCBs						IRIS
beta-BHC	P	C	1.8E+00	5.3E-04	Mouse	Oral-diet	Liver	IRIS
Chlordane (alpha & gamma isomers)	P	B2	1.3E+00 +	3.7E-04	Mouse	Oral-diet	Liver	IRIS
delta-BHC	P	D						IRIS
Dieldrin	P	B2	1.6E+01	4.6E-03	Mouse	Oral-diet	Liver	IRIS
Endosulfan	P	ND						
Endosulfan I	P	ND						
Endosulfan II	P	ND						
Endosulfan Sulfate	P	ND						
Endrin	P	ND						
Endrin aldehyde	P	ND						
Endrin ketone	P	ND						
Heptachlor	P	B2	4.5E+00	1.3E-03	Mouse	Oral-diet	Liver	IRIS
Heptachlor Epoxide	P	B2	9.1E+00	2.6E-03	Mouse	Oral-gavage	Liver	IRIS
Lindane (gamma-BHC)	P	B2-C	6.3E-02	1.8E-05	ND	ND	ND	CA EPA
Methoxychlor	P	D						IRIS
Polychlorinated Biphenyls (PCBs)	P	B2	See Below ***		Rat	Oral-diet	Liver	IRIS
high risk and persistence-central estimate	P		1.0E+00					
high risk and persistence-upper bound	P		2.0E+00					
low risk and persistence-central estimate	P		3.0E-01					
low risk and persistence-upper bound	P		4.0E-01					
lowest risk and persistence-central estimate	P		4.0E-02					

TABLE A4-2
INHALATION DOSE-RESPONSE DATA
FOR CARCINOGENIC EFFECTS

Olin Corporation
Wilmington, MA Facility

Compound	Chemical Group	Weight of Evidence	Inhalation Slope Factor[a] (mg/kg/day)$^{-1}$		Unit Risk (ug/m^3)$^{-1}$		Test Species	Study Type	Tumor Type	Source
lowest risk and persistence-upper bound	P		7.0E-02							
Toxaphene	P	B2	1.1E+00		3.2E-04		Mouse	Oral-diet	Liver	IRIS
VOLATILES										
1,1,1-Trichloroethane	V	D								IRIS
1,1,2,2-Tetrachloroethane	V	C	2.0E-01		5.8E-05		Mouse	Oral-gavage	Liver	IRIS
1,1,2-Trichloroethane	V	C	5.7E-02		1.6E-05		Mouse	Oral-gavage	Liver	IRIS
1,1-Dichloroethane	V	C	5.7E-03		1.6E-06		Rat	Oral-Gavage	Mammary gland	CA EPA
1,1-Dichloroethene	V	C	1.2E+00		5.0E-05		Mouse	Inhalation	Kidney	IRIS
1,2-Dichloroethane	V	B2	9.1E-02		2.6E-05		Rat	Oral-gavage	Hemangiosarcomas	IRIS
1,2-Dichloroethene (total)	V	ND								
cis-1,2-Dichloroethene	V	D								IRIS
trans-1,2-Dichloroethene	V	ND								
1,2-Dichloropropane	V	B2	6.3E-02		1.8E-05		Mouse	Oral-gavage	Liver	CAEPA
1,3,5-Trimethylbenzene	V	ND								
2,4,4-Trimethyl-1-pentene	V	ND								
2,4,4-Trimethyl-2-pentene	V	ND								
2-Butanone (Methyl ethyl ketone)	V	D								IRIS
2-Hexanone	V	ND								
4-Methyl-2-pentanone (MIBK)	V	ND								
Acetone	V	D								IRIS
Benzene	V	A	2.9E-02		8.3E-06		Human	Inhalation	Leukemia	IRIS
Bromodichloromethane	V	B2	1.3E-01		3.7E-05		ND	ND	ND	CA EPA
Bromoform	V	B2	3.9E-03		1.1E-06		Rat	Oral-gavage	Intestine	IRIS
Carbon Disulfide	V	ND								
Carbon Tetrachloride	V	B2	5.3E-02		1.5E-05		Several	Oral-gavage	Liver	IRIS
Chlorobenzene	V	D								IRIS
Chloroform	V	B2	8.1E-02		2.3E-05		Mouse	Oral-gavage	Liver	IRIS
Chloromethane	V	C	6.3E-03		1.8E-06		Mouse	Inhalation	Kidney	HEAST
Dibromochloromethane	V	C	ND		ND					IRIS
Ethyl chloride (Chloroethane)	V	ND								
Ethylbenzene	V	D								IRIS
Hexachlorobutadiene	V	C	7.8E-02		2.2E-05		Rat	Oral-diet	Kidney	IRIS
Methylene chloride (Dichloromethane)	V	B2	1.65E-03	c	4.7E-07		Mouse	Inhalation	Liver	IRIS
Styrene	V	ND								
Tetrachloroethene	V	B2	2.1E-02		5.9E-06		Mouse	Oral-gavage	Liver	CAEPA
Toluene	V	D								IRIS
Trichloroethene	V	B2	1.0E-02		2.0E-06	W	Mouse	Oral-gavage	Liver	CAEPA
Vinyl Acetate	V	ND								IRIS
Vinyl Chloride	V	A	3.0E-01		8.4E-05		Rat	Inhalation	Liver tumors	HEAST
Xylenes (total)	V	D								IRIS

TABLE A4-2
INHALATION DOSE-RESPONSE DATA
FOR CARCINOGENIC EFFECTS

Olin Corporation
Wilmington, MA Facility

Compound	Chemical Group	Weight of Evidence	Inhalation Slope Factor* (mg/kg/day)$^{-1}$	Unit Risk (µg/m^3)$^{-1}$	Test Species	Study Type	Tumor Type	Source

NOTES:

ND - Not determined/No data
W - Withdrawn from IRIS/HEAST
DW - Drinking water
µg - microgram
mg - milligram
kg - kilogram
IRIS - Integrated Risk Information System
HEAST - Health Effects Assessment Summary Tables
MADEP - Massachusetts Department of Environmental Protection
"Background Documentation for the Development of the MCP Numerical Standards" April, 1994
CA EPA - California Environmental Protection Agency
"California Environmental Protection Agency Criteria for Carcinogens" November, 1994

Sources (in order used, per MADEP, 1995):
IRIS as of 1/97
HEAST, 1995 (including July updates)
CA EPA, 1994
MADEP, 1994

* - Source of slope factor is HEAST, 1995 unless otherwise noted.
c - Calculated from unit risk (slope = ((unit risk x 70 kg)/20 m³/day) x 1000 ug/mg)
** - Slope factor for benzo(a)pyrene used for other carcinogenic PAHs, adjusted by Relative Potency Factors of 1.0 (benzo(a)pyrene, dibenz(a,h)anthracene); 0.1 (benzo(a)anthracene, benzo(b)flouoranthene, indeno(1,2,3-c,d)pyrene); 0.01 (benzo(k)fluoranthene); 0.001 (chrysene).
*** Slope factors are applicable to Aroclors 1016, 1248, 1254, and 1260.
\+ - Value for chlordane used for alpha- and gamma- isomers.

Chemical Groups:
A - Acid extractable
B - Base neutral extractable
I/M - Inorganic/Metal
P - Pesticide
V - Volatile
W - Waste

Weight of Evidence (Route-Specific):
A - Human carcinogen
B - Probable human carcinogen
B1 - limited evidence of cancer in humans
B2 - sufficient evidence of carcinogenicity in animals with inadequate or lack of evidence in humans
C - Possible human carcinogen
D - Not classifiable as to human carcinogenicity
E - Evidence of lack of carcinogenicity to humans

TABLE A4-3
ORAL DOSE-RESPONSE DATA
FOR NONCARCINOGENIC EFFECTS

Olin Corporation
Wilmington, MA Facility

Compound	CHEMICAL SOURCE	CHRONIC ORAL RfD (mg/kg-day)		SUBCHRONIC ORAL RfD* (mg/kg-day)		STUDY TYPE	CONFIDENCE LEVEL	CRITICAL EFFECT	TEST ANIMAL	UNCERTAINTY FACTOR	SOURCE
ACID EXTRACTABLE COMPOUNDS											
2,4,6-Trichlorophenol	A	4.2E-02		ND		Oral-DW	ND	Reduced litter size	Rat	100 H,A	ATSDR, 1990
2,4-Dichlorophenol	A	3.0E-03		3.0E-03		Oral-DW	Low	Altered immune function	Rat	100 H,A	IRIS
2,4-Dimethylphenol	A	2.0E-02		2.0E-01		Oral-gavage	Low	Adverse clinical signs	Mouse	3,000 H,A,D	IRIS
2,4-Dinitrophenol	A	2.0E-03		2.0E-03		Oral-diet	Low	Cataracts	Human	1,000 H,S,L	IRIS, MADEP
2-Chlorophenol	A	5.0E-03		5.0E-02		Oral-DW	Low	Reproductive effects	Rat	1,000 H,A,S	IRIS
2-Methylphenol (o-Cresol)	A	5.0E-02		5.0E-01		Oral-gavage	Medium	Reduced body weight; neurotoxicity	Rat	1,000 H,A,S	IRIS
2-Nitrophenol	A	8.0E-03		ND		ND	ND	ND	ND	ND	USEPA
4,6-Dinitro-2-methylphenol	A	2.0E-03	+	2.0E-03	+						IRIS, MADEP
4-Chloro-3-methylphenol	A			2.0E+00		Oral-gavage	ND	Decreased weight gain	Rat	100	HEAST
4-Methylphenol (p-Cresol)	A	5.0E-03		5.0E-03		Oral-gavage		Maternal death	Rabbit	1,000	HEAST
4-Nitrophenol	A	8.0E-03		ND		ND	ND	ND	ND	ND	USEPA
Benzoic Acid	A	4.0E+00		4.0E+00		Oral-diet	Medium	No adverse effects observed	Human	1	IRIS
Phenol	A	6.0E-01		6.0E-01		Oral-gavage	Low	Reduced fetal body weight	Rat	100 H,A	IRIS
BASE NEUTRAL COMPOUNDS											
1,2,3-Trichlorobenzene	B	1.0E-02	+	1.0E-02	+ +						IRIS
1,2,4-Trichlorobenzene	B	1.0E-02		1.0E-02		Oral-DW	Medium	Increased adrenal weights	Rat	1,000 H,A,S	IRIS
1,2-Dichlorobenzene	B	9.0E-02		9.0E-01		Oral-diet	Low	No adverse effects observed	Rat	1,000 H,A,D	IRIS
1,3-Dichlorobenzene	B	9.0E-02		9.0E-01		Oral-diet	Low	No adverse effects observed	Rat	1,000 H,A,D	MADEP
1,4-Dichlorobenzene	B, V	9.0E-02		9.0E-01		Oral-diet	Low	No adverse effects observed	Rat	1,000 H,A,D	MADEP
2,6-Dinitrotoluene	B	1.0E-03		1.0E-02		Oral-diet		Mortality; neurotoxicity	Dog	3,000	HEAST
2-Methylnaphthalene	B	3.0E-02	*	3.0E-02	*						MADEP
4-Bromophenyl-phenylether	B	ND									
4-Chloroaniline	B	4.0E-03		4.0E-03		Oral-diet	Low	Splenic capsule lesions	Rat	3,000 H,A,L,D	IRIS
4-Chlorophenyl-phenylether	B	ND									
4-Nitroaniline	B	4.0E-03	-	4.0E-03	-						IRIS
Acenaphthene	B	6.0E-02		6.0E-01		Oral-gavage	Low	Hepatoxicity	Mouse	3,000 H,A,S,D	IRIS
Acenaphthylene	B	3.0E-02	*	3.0E-02	*						IRIS
Anthracene	B	3.0E-01		3.0E+00		Oral-gavage	Low	No effects observed	Mouse	3,000 H,A,S	IRIS
Benzo(a)anthracene	B	3.0E-02	*	3.0E-02	*						IRIS
Benzo(a)pyrene	B	3.0E-02	*	3.0E-02	*						IRIS
Benzo(b)fluoranthene	B	3.0E-02	*	3.0E-02	*						IRIS
Benzo(g,h,i)perylene	B	3.0E-02	*	3.0E-02	*						IRIS
Benzo(k)fluoranthene	B	3.0E-02	*	3.0E-02	*						IRIS
Benzyl Alcohol	B	3.0E-01		1.0E+00		Oral-gavage	Low	Epithelial hyperplasia	Rat	1,000	HEAST
Bis(2-ethylhexyl)phthalate (BEHP)	B	2.0E-02		2.0E-02		Oral-diet	Medium	Increased liver weight	Guinea Pig	1,000 H,A,S	IRIS, MADEP
Bis(Chloromethyl)ether	B	4.0E-02	- -	4.0E-02	- -	Oral-diet	Low	Decreased hemoglobin	Mouse	1,000 H,A,D	IRIS
Butyl Benzyl Phthalate	B	2.0E-01		2.0E+00		Oral-diet	Low	Liver weight	Rat	1,000 H,A,S	IRIS
Chrysene	B	3.0E-02	*	3.0E-02	*						IRIS
Di-n-butyl Phthalate	B	1.0E-01		1.0E+00		Oral-diet	Low	Increased mortality	Rat	1,000 H,A,S	IRIS
Di-n-octyl Phthalate	B	2.0E-02		2.0E-02		Oral-diet	Low	Elevated kidney weight	Rat	1,000	HEAST
Dibenzo(a,h)anthracene	B	3.0E-02	*	3.0E-02	*						IRIS
Dibenzofuran	B	3.0E-02	*	3.0E-02	*						IRIS
Diethyl phthalate	B	8.0E-01		8.0E+00		Oral-diet	Low	Decreased growth rate	Rat	1,000 H,A,S	IRIS
Dimethyl phthalate	B	1.0E+00		1.0E+01		Oral-diet	ND	Adverse kidney effects	Rat	100	MADEP
Fluoranthene	B	4.0E-02		4.0E-01		Oral-gavage	Medium	Increased liver weight	Mouse	3,000 H,A,S	IRIS
Fluorene	B	4.0E-02		4.0E-01		Oral-gavage	Low	Hematologic changes	Mouse	3,000 H,A,S	IRIS
Hexachlorobenzene	B	8.0E-04		8.0E-04		Oral-diet	Medium	Liver effects	Rat	100 H,A	IRIS, MADEP
Indeno(1,2,3-cd)pyrene	B	3.0E-02	*	3.0E-02	*						IRIS

TABLE A4-3
ORAL DOSE-RESPONSE DATA
FOR NONCARCINOGENIC EFFECTS

Olin Corporation
Wilmington, MA Facility

Compound	CHEMICAL SOURCE	CHRONIC ORAL RfD (mg/kg-day)	SUBCHRONIC ORAL RfD (mg/kg-day)	STUDY TYPE	CONFIDENCE LEVEL	CRITICAL EFFECT	TEST ANIMAL	UNCERTAINTY FACTOR	SOURCE
Isophorone	B	2.0E-01	2.0E+00	Oral-capsule	Low	No effects observed	Dog	1,000 H,A,S	IRIS
n-Nitrosodi-n-propylamine	B	ND	9.5E-02	Oral-DW	ND	Hepatoxicity	Mouse	100 H,A	ATSDR, 1989
n-Nitrosodiphenylamine	B	5.0E-02	ND	Oral-diet	ND	Bladder epithelial hyperplasia	Rat	1,000 H,A,L	ATSDR, 1992
Naphthalene	B, V	4.0E-02 W	4.0E-02	Oral-gavage	ND	Decreased body weight	Rat	1000	MADEP
Nitrobenzene	B	5.0E-04	5.0E-03	Inhalation	Low	Hematologic, adrenal,renal, hepatic lesions	Rat/Mouse	10,000 H,A,S,L	IRIS
Phenanthrene	B	3.0E-02 *	3.0E-02 *						IRIS
Pyrene	B	3.0E-02	3.0E-01	Oral-gavage	Low	Renal tubular pathology	Mouse	3,000 H,A,S,D	IRIS
INORGANICS/METALS									
Aluminum	I/M	ND	ND						
Antimony	I/M	4.0E-04	4.0E-04	Oral-DW	Low	Reduced lifespan	Rat	1,000 H,A,L	IRIS
Arsenic	I/M	3.0E-04	3.0E-04	Oral-DW	Medium	Keratosis and hyperpigmentation	Human	3 H	IRIS
Barium	I/M	7.0E-02	7.0E-02	Oral-DW	Medium	Increased blood pressure	Human	3 H	IRIS
Beryllium	I/M	5.0E-03	5.0E-03	Oral-DW	Low	No effects observed	Rat	100 H,A	IRIS
Cadmium (food)	I/M	1.0E-03	None	Oral-diet	High	Proteinuria	Human	10 H	IRIS
Cadmium (water)	I/M	5.0E-04	None	Oral-DW	High	Proteinuria	Human	10 H	IRIS
Calcium	I/M	ND							
Chromium III	I/M	1.0E+00	1.0E+00	Oral-diet	Low	No effects observed	Rat	100 H,A; 10 M	IRIS
Chromium VI	I/M	5.0E-03	2.0E-02	Oral-DW	Low	No effects observed	Rat	500 H,A,S	IRIS
Chloride	I/M	ND							
Cobalt (adult)	I/M	1.8E-01	ND	Oral-diet	ND	NOAEL for polycythemia	Human	ND	NCEA, 1994
Cobalt (child)	I/M	6.0E-02	ND	Oral-diet	ND	NOAEL for polycythemia	Human	ND	NCEA, 1994
Copper	I/M	ND	ND						
Cyanide	I/M	2.0E-02	2.0E-02	Oral-diet	Medium	No effects observed	Rat	100 H,A; 5 M	IRIS
Iron	I/M	ND	ND						
Lead	I/M	7.5E-04	7.5E-04						MADEP
Magnesium	I/M	ND							
Manganese (drinking water)	I/M	2.4E-02 I	ND					1,3,2 M	IRIS
Manganese (food)	I/M	1.4E-01	ND	Oral-diet	Medium	CNS effects	Human	1, 1 M	IRIS
Manganese (soil)	I/M	4.7E-02 II	ND					1, 3 M	IRIS
Mercury (as mercuric chloride)	I/M	3.0E-04	3.0E-04	Oral-diet	High	Autoimmune effects	Rat	H,A,S,L	IRIS
Nickel	I/M	2.0E-02	2.0E-02	Oral-diet	Medium	Decreased body and organ weights	Rat	300 H,A,D	IRIS
Nitrate	I/M	1.6E+00	ND	Oral-DW	High	Early clinical signs of methemoglobinemia	Human	1	IRIS
Nitrite	I/M	1.0E-01	1.0E-01	Oral-DW	High	Early clinical signs of methemoglobinemia	Human	1	IRIS
Nitrogen, Ammonia	I/M	9.7E-01 ***	ND	Oral-DW	ND	Organoleptic effects	Human	1	HEAST
Potassium	I/M	ND							
Selenium	I/M	5.0E-03	5.0E-03	Oral-diet	High	Clinical selenosis	Human	3 H	IRIS
Silver	I/M	5.0E-03	5.0E-03	Intravenous	Low	Argyria	Human	3 H	IRIS
Sodium	I/M	ND							
Strontium	I/M	6.0E-01	ND	Oral-diet	Medium	Rachitic bones	Rat	300 H,A,D	IRIS
Sulfates as SO_4	I/M	1.4E+01 **	ND	Oral - DW	ND	Laxative effects			USEPA
Sulfide	I/M	ND							
Thallium (based on thallium sulfate)	I/M	8.0E-05	8.0E-04	Oral-gavage	Low	No effects observed	Rat	3,000 H,A,S,D	IRIS
Vanadium	I/M	7.0E-03	7.0E-03	Oral-DW	Low	No effects observed	Rat	100 H,A	HEAST
Zinc	I/M	3.0E-01	3.0E-01	Oral-diet	Medium	Decreased ESOD activity	Human	3 H	IRIS
PESTICIDES/PCBs									
4,4'-DDD	P	5.0E-04 **	5.0E-04 **						IRIS
4,4'-DDE	P	5.0E-04 **	5.0E-04 **						IRIS
4,4'-DDT	P	5.0E-04	5.0E-04	Oral-diet	Medium	Liver lesions	Rat	100 H,A	IRIS
Aldrin	P	3.0E-05	3.0E-05	Oral-diet	Medium	Liver lesions	Rat	1,000 H,A,L	IRIS

TABLE A4-3
ORAL DOSE-RESPONSE DATA
FOR NONCARCINOGENIC EFFECTS

Olin Corporation
Wilmington, MA Facility

Compound	CHEMICAL SOURCE	CHRONIC ORAL RfD (mg/kg-day)		SUBCHRONIC ORAL RfD[1] (mg/kg-day)		STUDY TYPE	CONFIDENCE LEVEL	CRITICAL EFFECT	TEST ANIMAL	UNCERTAINTY FACTOR	SOURCE
alpha-BHC	P	5.0E-04		ND		Oral-diet	ND	Hepatic cellular hypertrophy	Rat	1,000 H,A,L	ATSDR, 1993
Aroclor 1016	P	7.0E-05		ND		Oral-diet	Medium	Reduced birth weights	Monkey	100 H,A,D,S	IRIS
beta-BHC	P	5.0E-04		ND		Oral-diet	ND	Hepatic cellular hypertrophy	Rat	1,000 H,A,L	ATSDR, 1993
Chlordane (alpha & gamma isomers)	P	6.0E-05	`	6.0E-05	`	Oral-diet	Low	Liver hypertrophy	Rat	1,000 H,A	IRIS
delta-BHC	P	5.0E-04		ND		Oral-diet	ND	Hepatic cellular hypertrophy	Rat	1,000 H,A,L	ATSDR, 1993
Dieldrin	P	5.0E-05		5.0E-05		Oral-diet	Medium	Liver lesions	Rat	100 H,A	IRIS
Endosulfan	P	6.0E-03		6.0E-03		Oral-diet	Medium	Kidney lesions	Rat	100 H,A	IRIS
Endosulfan I	P	6.0E-03	-	6.0E-03	-						IRIS
Endosulfan II	P	6.0E-03	-	6.0E-03	-						IRIS
Endosulfan Sulfate	P	6.0E-03	-	6.0E-03	-						IRIS
Endrin	P	3.0E-04		3.0E-04		Oral-diet	Medium	Convulsions & liver lesions	Dog	100 H,A	IRIS
Endrin aldehyde	P	3.0E-04	--	3.0E-04	--						IRIS
Endrin ketone	P	3.0E-04	--	3.0E-04	--						IRIS
Heptachlor	P	5.0E-04		5.0E-04		Oral-diet	Low	Increased liver weight	Rat	300 H,A	IRIS
Heptachlor Epoxide	P	1.3E-05		1.3E-05		Oral-diet	Low	Increased liver weight	Dog	1,000 H,A,N	IRIS
Lindane (gamma-BHC)	P	3.0E-04		3.0E-03		Oral-diet	Medium	Liver and kidney toxicity	Rat	1,000 H,A,S	IRIS
Methoxychlor	P	5.0E-03		5.0E-03		Oral-gavage	Low	Loss of litters	Rabbit	1,000 H,A,D	IRIS
Polychlorinated Biphenyl (PCBs)	P	2.0E-05	***	5.0E-05	***	Oral-diet	Medium	Immunotoxicity	Monkey	300 H,A,S	IRIS
Toxaphene	P	5.0E-05		ND		Oral-diet	ND	Behavioral changes	Rat	1,000 H,A,L	ATSDR, 1990
VOLATILES											
1,1,1-Trichloroethane	V	9.0E-01	W	9.0E-02		Oral-diet	ND	Hepatotoxicity	Guinea Pig	100	MADEP
1,1,2,2-Tetrachloroethane	V	3.0E-02	III	3.0E-02	III	Oral-gavage	ND	Liver lesions	Rat	3000	HEAST
1,1,2-Trichloroethane	V	4.0E-03		4.0E-02		Oral-DW	Medium	Clinical serum chemistry alterations	Mouse	1,000 H,A,S	IRIS
1,1-Dichloroethane	V	1.0E-01		1.0E+00		Inhalation		None observed	Rat	1,000	HEAST
1,1-Dichloroethene	V	9.0E-03		9.0E-03		Oral-DW	Medium	Hepatic lesions	Rat	1,000 H,A,L	IRIS
1,2-Dichloroethane	V	2.0E-01		2.0E-02		Inhalation	ND	NOAEL	Rat	1,000 H,A,S	MADEP
1,2-Dichloroethene (total)	V	9.0E-03		9.0E-03		Oral-DW	ND	Liver lesions	Rat	1,000	HEAST
1,2-Dichloroethene (cis)	V	1.0E-02		1.0E-01		Oral-gavage		Decreased hematocrit and hemoglobin	Rat	3,000	HEAST
1,2-Dichloroethene (trans)	V	2.0E-02		2.0E-01		Oral-DW	Low	Increased serum alkaline phosphatase	Mouse	1,000 H,A,S	IRIS
1,2-Dichloropropane	V	6.2E-01				Oral-gavage	ND	Decreased body weight	Rat	100 H,A	ATSDR, 1989
1,3,5-Trimethylbenzene	V	2.0E+00	++	4.0E+00	++						IRIS
2,4,4-Trimethyl-1-pentene	V	2.1E-01		2.1E-01		Oral-gavage	ND	Hepatic changes	Rat	1,000 H,A,L	ABB-ES
2,4,4-Trimethyl-2-pentene	V	2.1E-01		2.1E-01		Oral-gavage	ND	Hepatic changes	Rat	1,000 H,A,L	ABB-ES
2-Butanone (Methyl Ethyl Ketone)	V	6.0E-01		2.0E+00		Oral-DW	Low	Decreased fetal birth weight	Rat	3,000 H,A,S,D	IRIS
2-Hexanone	V	6.0E-01	---	2.0E+00	---						IRIS
4-Methyl-2-pentanone (MIBK)	V	8.0E-02	W	8.0E-01		Oral-gavage		Liver and kidney effects	Rat	3,000	HEAST
Acetone	V	1.0E-01		1.0E+00		Oral-gavage	Low	Increased liver and kidney weights	Rat	1,000 H,A,S	IRIS
Benzene	V	5.0E-03		5.0E-02		Inhalation	ND	Leukopenia	Rat	1,000 H,A,S	MADEP
Bromodichloromethane	V	2.0E-02		2.0E-02		Oral-gavage	Medium	Renal cytomegaly	Mouse	1,000 H,A,L,D	IRIS
Bromoform	V	2.0E-02		2.0E-01		Oral-gavage	Medium	Hepatic lesions	Rat	1,000 H,A,S	IRIS
Carbon Disulfide	V	1.0E-01		1.0E-01		Inhalation	Medium	Fetal toxicity/teratogenicity	Rabbit	100 H,A	IRIS
Carbon Tetrachloride	V	7.0E-04		7.0E-04		Oral-gavage	Medium	Liver lesions	Rat	1,000 H,A,S	IRIS, MADEP
Chlorobenzene	V	2.0E-02		2.0E-01		Oral-capsule	Medium	Hepatic changes	Dog	1,000 H,A,S	IRIS, MADEP
Chloroform	V	1.0E-02		1.0E-02		Oral-capsule	Medium	Fatty cyst formation in liver	Dog	1,000 H,A,S	IRIS
Chloromethane	V	4.0E-03		ND		ND	ND	ND	ND	ND	USEPA
Dibromochloromethane	V	2.0E-02		2.0E-01		Oral-gavage	Medium	Hepatic lesions	Rat	1,000 H,A,S	IRIS
Ethyl chloride (Chlorethane)	V	4.0E-03	---	ND							USEPA
Ethylbenzene	V	1.0E-01		1.0E+00		Oral-gavage	Low	Liver and kidney toxicity	Rat	1,000 H,A,S	IRIS, MADEP
Hexachlorobutadiene	V	2.0E-04		ND		Oral-diet	Low	Kidney toxicity	Rat	100 H,A	HEAST

TABLE A4-3
ORAL DOSE-RESPONSE DATA
FOR NONCARCINOGENIC EFFECTS

Olin Corporation
Wilmington, MA Facility

Compound	CHEMICAL SOURCE	CHRONIC ORAL RfD (mg/kg-day)	SUBCHRONIC ORAL RfD[1] (mg/kg-day)	STUDY TYPE	CONFIDENCE LEVEL	CRITICAL EFFECT	TEST ANIMAL	UNCERTAINTY FACTOR	SOURCE
Methylene Chloride (Dichloromethane)	V	6.0E-02	6.0E-02	Oral-DW	Medium	Liver toxicity	Rat	100 H,A	IRIS
Styrene	V	2.0E-01	2.0E+00	Oral-gavage	Medium	Red blood cell and liver effects	Dog	1,000 H,A,S	IRIS, MADEP
Tetrachloroethene	V	1.0E-02	1.0E-01	Oral-gavage	Medium	Hepatotoxicity	Mouse	1,000 H,A,S	IRIS
Toluene	V	2.0E-01	2.0E+00	Oral-gavage	Medium	Weight change in liver and kidneys	Rat	1,000 H,A,S	IRIS
Trichloroethene	V	2.0E-03	2.0E-02	Inhalation	ND	Increased liver weight	Rat	10,000 H,A,S,L	MADEP
Vinyl Acetate	V	1.0E+00	1.0E+00	Oral-DW	Low	Altered whole body & kidney weight	Rat	100 H,A	HEAST
Vinyl Chloride	V	1.0E-03	1.0E-03	Oral-diet	ND	Liver lesions	Rat	100 H,A	MADEP
Xylenes (total)	V	2.0E+00	4.0E+00	Oral-gavage	Medium	Hyperactivity, decreased body weight	Rat	100 H,A	IRIS, MADEP

NOTES:

ND - No data available
W - RfD withdrawn from IRIS/HEAST
mg - milligram
kg - kilogram
DW - Drinking Water
IRIS - Integrated Risk Information System
HEAST - Health Effects Assessment Summary Tables
USEPA - United States Environmental Protection Agency (Office of Water;
"Drinking Water Regulations and Health Advisories")
NCEA - National Center for Environmental Assessment (formerly ECAO)
ATSDR - Agency for Toxic Substances Disease Registry (Toxicological Profiles; chemical-specific)
MADEP - Massachusetts Department of Environmental Protection
"Background Documentation for the Development of the MCP Numerical Standards" April, 1994

Uncertainty factors:
H - variation in human sensitivity
A - animal to human extrapolation
S - extrapolation from subchronic to chronic NOAEL
L - extrapolation from LOAEL to NOAEL
N - NOEL not attained
D - Lack of supporting data
M - additional modifying factor

SOURCES (in order used, per MADEP, 1995):
IRIS as of 1/97; chronic RfDs
HEAST, 1995 (including July update); chronic and subchronic RfDs
MADEP, 1994; RfDs
ATSDR (chemical-specific); Minimum Risk Levels (MRLs)
USEPA; RfDs
NCEA, 1994. This RfD was provided in response to a specific request; documentation of RfD is provided in this appendix.

[1] - Source for all subchronic RfDs is HEAST (1995) if chronic RfD is from IRIS or HEAST,
unless otherwise indicated.
*RfD for pyrene is used as surrogate for PAHs without assigned RfD
**RfD for DDT is used as surrogate
***RfD for Aroclor 1254 used as surrogate
~RfD for Endosulfan used as surrogate
~~ RfD for Endrin used as surrogate
~~~ RfD for chloromethane used as surrogate
! RfD for manganese in food divided by modifying factor of 3
!! RfD for manganese in food divided by 2 to account for dietary exposure, and by
3 as a modifying factor.
!!! RfD for 1,1,1,2-tetrachloroethane used as surrogate
+ RfD for 2,4-dinitrophenol used as surrogate
++ RfD for xylenes used as surrogate
+++ RfD for 1,2,4-trichlorobenzene used as surrogate
^ RfD for 4-chloroaniline used as surrogate
^^ RfD for bis(2-chloroisopropyl)ether used as surrogate
^^^ RfD for 2-butanone used as surrogate
` Value for chlordane used for alpha- and gamma- isomers.
`` Value is the proposed MCL (500 mg/L), converted to a dose (2 L/day x 500 mg/L / 70 kg)
``` Value is the drinking water value (34 mg/L), converted to a dose (2 L/day x 500 mg/L / 70 kg)

Chemical Group:
A - Acid extractable
B - Base neutral extractable
I/M - Inorganic/Metal
P - Pesticide
V - Volatile
W - Waste
X - Other
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TABLE A4-4
INHALATION DOSE-RESPONSE DATA
FOR NONCARCINOGENIC EFFECTS

Olin Corporation
Wilmington, MA Facility

| COMPOUND | CHEMICAL GROUP | CHRONIC INHALATION RfC (mg/m3) | SUBCHRONIC INHALATION RfC (mg/m3) | CHRONIC INHALATION RfDi (mg/kg-day) | SUBCHRONIC INHALATION RfDi (mg/kg-day) | STUDY TYPE | CONFIDENCE LEVEL | CRITICAL EFFECT | TEST ANIMAL | UNCERTAINTY FACTOR | SOURCE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **ACID EXTRACTABLE** | | | | | | | | | | | |
| 2,4,6-Trichlorophenol | A | ND | ND | ND | ND | | | | | | |
| 2,4-Dichlorophenol | A | ND | ND | ND | ND | | | | | | |
| 2,4-Dimethylphenol | A | ND | ND | ND | ND | | | | | | |
| 2,4-Dinitrophenol | A | ND | ND | ND | ND | | | | | | |
| 2-Chlorophenol | A | ND | ND | ND | ND | | | | | | |
| 2-Methylphenol (o-cresol) | A | 1.0E-01 ++ | ND | ND | ND | | | | | | ATC |
| 2-Nitrophenol | A | ND | 3.0E-02 | ND | ND | Inhalation | ND | Hematologic effects | Rat | 100 H,A | ATSDR, 1991 |
| 4,6-Dinitro-2-methylphenol | A | ND | ND | ND | ND | | | | | | |
| 4-Chloro-3-methylphenol | A | ND | ND | ND | ND | | | | | | |
| 4-Methylphenol (p-Cresol) | A | 1.0E-01 | ND | ND | ND | | | | | | ATC |
| 4-Nitrophenol | A | ND | 3.0E-02 | ND | ND | Inhalation | ND | Hematologic effects | Rat | 100 H,A | ATSDR, 1991 |
| Benzoic Acid | A | ND | ND | ND | ND | | | | | | |
| Phenol | A | 2.6E-01 | ND | ND | ND | | | | | | MADEP |
| **BASE NEUTRAL COMPOUNDS** | | | | | | | | | | | |
| 1,2,3-Trichlorobenzene | B | 2.0E-01 + | 2.0E+00 + | | | | | | | | HEAST |
| 1,2,4-Trichlorobenzene | B | 2.0E-01 | 2.0E+00 | 3.0E-03 [3] | 3.0E-02 [3] | Inhalation | Low | Liver weight change | Rat/Rabbit | 1,000 H,A,S | HEAST[3] |
| 1,2-Dichlorobenzene | B | 2.0E-01 | 2.0E+00 | 4.0E-02 [3] | ND | Inhalation | Low | Decreased weight gain | Rat | 1,000 H,A,S | HEAST[3] |
| 1,3-Dichlorobenzene | B | 2.0E-01 ** | 2.0E+00 ** | ND | ND | | | | | | HEAST |
| 1,4-Dichlorobenzene | B, V | 8.0E-01 | 2.5E+00 | 2.3E-01 | 7.1E-01 | Inhalation | Medium | Increased liver weight | Rat | 100 H,A,S | IRIS |
| 2,6-Dinitrotoluene | B | ND | ND | ND | ND | | | | | | |
| 2-Methylnaphthalene | B | 7.1E-02 | ND | ND | ND | | | | | | MADEP |
| 4-Bromophenyl-phenylether | B | ND | ND | ND | ND | | | | | | |
| 4-Chloroaniline | B | 2.0E-04 *** | 2.0E-03 ** | ND | ND | | | | | | HEAST |
| 4-Chlorophenyl-phenylether | B | ND | ND | ND | ND | | | | | | |
| 4-Nitroaniline | B | 2.0E-04 *** | 2.0E-03 ** | ND | ND | Inhalation | ND | Hematological effects | Rat | 10000 | HEAST[4] |
| Acenaphthene | B | 7.1E-02 * | ND | ND | ND | | | | | | MADEP |
| Acenaphthylene | B | 7.1E-02 * | ND | ND | ND | | | | | | MADEP |
| Anthracene | B | 7.1E-02 * | ND | ND | ND | | | | | | MADEP |
| Benzo(a)anthracene | B | 7.1E-02 * | ND | ND | ND | | | | | | MADEP |
| Benzo(a)pyrene | B | 7.1E-02 * | ND | ND | ND | | | | | | MADEP |
| Benzo(b)fluoranthene | B | 7.1E-02 * | ND | ND | ND | | | | | | MADEP |
| Benzo(g,h,i)perylene | B | 7.1E-02 * | ND | ND | ND | | | | | | MADEP |
| Benzo(k)fluoranthene | B | 7.1E-02 * | ND | ND | ND | | | | | | MADEP |
| Benzyl Alcohol | B | ND | ND | ND | ND | | | | | | |
| Bis(2-ethylhexyl)phthalate (BEHP) | B | 7.0E-03 | ND | ND | ND | | | | | | MADEP |
| bis(Chloromethyl)ether | B | 3.0E-04 | ND | ND | ND | Inhalation | | Respiratory effects | Rat | 100 H,A | ATSDR, 1989 |
| Butylbenzylphthalate | B | 7.0E-03 ** | ND | ND | ND | | | | | | MADEP |
| Chrysene | B | 7.1E-02 * | ND | ND | ND | | | | | | MADEP |
| Di-n-butylphthalate | B | 7.0E-03 ** | ND | ND | ND | | | | | | MADEP |
| Di-n-octylphthalate | B | 7.0E-03 ** | ND | ND | ND | | | | | | MADEP |
| Dibenzo(a,h)anthracene | B | 7.1E-02 * | ND | ND | ND | | | | | | MADEP |
| Dibenzofuran | B | ND | ND | ND | ND | | | | | | IRIS |
| Diethylphthalate | B | 7.0E-03 ** | ND | ND | ND | | | | | | MADEP |
| Dimethyl phthalate | B | 7.0E-03 ** | ND | ND | ND | | | | | | MADEP |
| Fluoranthene | B | 7.1E-02 * | ND | ND | ND | | | | | | MADEP |
| Fluorene | B | 7.1E-02 * | ND | ND | ND | | | | | | MADEP |
| Hexachlorobenzene | B | ND | ND | ND | ND | | | | | | IRIS |
| Indeno(1,2,3-cd)pyrene | B | 7.1E-02 * | ND | ND | ND | | | | | | MADEP |
| Isophorone | B | ND | ND | ND | ND | | | | | | IRIS |
| n-Nitrosodi-n-propylamine | B | ND | ND | ND | ND | | | | | | IRIS |
| n-Nitrosodiphenylamine | B | ND | ND | ND | ND | | | | | | IRIS |

TABLE A4-4
INHALATION DOSE-RESPONSE DATA
FOR NONCARCINOGENIC EFFECTS

Olin Corporation
Wilmington, MA Facility

| COMPOUND | CHEMICAL GROUP | CHRONIC INHALATION RfC (mg/m3)[1] | SUBCHRONIC(1) INHALATION RfC (mg/m3)[1] | CHRONIC INHALATION RfD(2) (mg/kg-day) | SUBCHRONIC INHALATION RfD(2) (mg/kg-day) | STUDY TYPE | CONFIDENCE LEVEL | CRITICAL EFFECT | TEST ANIMAL | UNCERTAINTY FACTOR | SOURCE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Naphthalene | B, V | 7.1E-02 | ND | ND | ND | | | | | | MADEP |
| Nitrobenzene | B | 2.0E-03 | 2.0E-02 | 5.7E-04 [3] | 5.7E-03 [3] | Inhalation | Low | Adrenal, liver, kidney lesions | Mouse | 10,000 H,A,S,L | HEAST[3] |
| Phenanthrene | B | 7.1E-02 * | ND | ND | ND | | | | | | MADEP |
| Pyrene | B | 7.1E-02 * | ND | ND | ND | | | | | | MADEP |
| INORGANICS/METALS | | | | | | | | | | | |
| Aluminum | I/M | ND | ND | ND | ND | | | | | | |
| Antimony | I/M | 1.0E-02 | ND | ND | ND | | | | | | ATC |
| Arsenic | I/M | 2.5E-06 | ND | ND | ND | | | | | | ATC |
| *Barium* | I/M | 5.0E-04 | 5.0E-03 | 1.4E-04 [3] | 1.4E-03 [3] | Inhalation | *Low* | *Fetotoxicity* | *Rat* | 1,000 H,A,S | HEAST[3] |
| Beryllium | I/M | 5.0E-06 | ND | ND | ND | | | | | | ATC |
| Cadmium | I/M | 2.0E-04 | ND | ND | ND | Inhalation | ND | Renal effects | Human | 10 H | ATSDR, 1993 |
| Calcium | I/M | ND | ND | ND | ND | | | | | | |
| Chloride | I/M | ND | ND | ND | ND | | | | | | |
| Chromium III | I/M | 6.8E-03 | ND | ND | ND | | | | | | ATC |
| Chromium VI | I/M | 2.0E-05 | ND | ND | ND | Inhalation | ND | Respiratory effects | Human | 10 H | ATSDR, 1993 |
| Cobalt | I/M | ND | ND | ND | ND | | | | | | |
| Copper | I/M | 2.7E-03 | ND | ND | ND | | | | | | ATC |
| Cyanide | I/M | 1.0E-03 | 7.0E-03 | ND | ND | | | | | | MADEP |
| Iron | I/M | ND | ND | ND | ND | | | | | | |
| Lead | I/M | 7.0E-04 [5] | ND | ND | ND | | | | | | ATC |
| Magnesium | I/M | ND | ND | ND | ND | | | | | | |
| Manganese | I/M | 5.0E-05 | ND | 1.4E-05 | ND | Inhalation | Medium | Neurobehavioral impairment | Human | 1,000 H,L,D | IRIS |
| Mercury (as elemental mercury) | I/M | 3.0E-04 | 3.0E-04 | 8.6E-05 | 8.6E-05 | Inhalation | Low | Neurotoxicity | Human | 30 H,D | HEAST[4] |
| Nickel | I/M | 9.0E-06 | ND | ND | ND | Inhalation | ND | Respiratory effects | Rat | 1,000 H,A,L | ATSDR, 1992 |
| Nitrate | I/M | ND | ND | ND | ND | | | | | | |
| Nitrite | I/M | ND | ND | ND | ND | | | | | | |
| Nitrogen, Ammonia | I/M | 1.0E-01 | 1.0E-01 | ND | ND | Inhalation | Medium | Lack of respiratory effects | Human | 30 H,D | IRIS |
| Potassium | I/M | ND | ND | ND | ND | | | | | | |
| Selenium | I/M | 2.7E-03 | ND | ND | ND | | | | | | ATC |
| Silver | I/M | ND | ND | ND | ND | | | | | | |
| Sodium | I/M | ND | ND | ND | ND | | | | | | |
| Strontium | I/M | ND | ND | ND | ND | | | | | | |
| Sulfates as $SO_4$ | I/M | ND | ND | ND | ND | | | | | | |
| Sulfide | I/M | ND | ND | | | | | | | | |
| Thallium | I/M | ND | ND | ND | ND | | | | | | |
| Vanadium | I/M | 1.4E-03 | 6.0E-03 | ND | ND | Inhalation | ND | Respiratory effects | Human | 10 H | ATC/ATSDR, 1991 |
| Zinc | I/M | ND | ND | ND | ND | | | | | | |
| PESTICIDES/PCBs | | | | | | | | | | | |
| 4,4'-DDD | P | ND | ND | ND | ND | | | | | | |
| 4,4'-DDE | P | ND | ND | ND | ND | | | | | | |
| 4,4'-DDT | P | ND | ND | ND | ND | | | | | | |
| Aldrin | P | ND | ND | ND | ND | | | | | | |
| alpha-BHC | P | 7.0E-04 ** | ND | ND | ND | | | | | | ATC |
| Aroclor 1016 | P | 2.0E-05 * | ND | ND | ND | | | | | | MADEP |
| beta-BHC | P | 7.0E-04 ** | ND | ND | ND | | | | | | ATC |
| Chlordane (alpha & gamma isomers) | P | 7.0E-04 * | ND | ND | ND | | | | | | MADEP |
| delta-BHC | P | 7.0E-04 ** | ND | ND | ND | | | | | | ATC |
| Dieldrin | P | ND | ND | ND | ND | | | | | | |
| Endosulfan | P | ND | ND | ND | ND | | | | | | |
| Endosulfan I | P | ND | ND | ND | ND | | | | | | |
| Endosulfan II | P | ND | ND | ND | ND | | | | | | |
| Endosulfan Sulfate | P | ND | ND | ND | ND | | | | | | |

**TABLE A4-4**
**INHALATION DOSE-RESPONSE DATA**
**FOR NONCARCINOGENIC EFFECTS**

**Olin Corporation**
**Wilmington, MA Facility**

| COMPOUND | CHEMICAL GROUP | CHRONIC INHALATION RfC (mg/m[3]) | SUBCHRONIC[1] INHALATION RfC (mg/m[3]) | CHRONIC INHALATION RfD[2] (mg/kg-day) | SUBCHRONIC INHALATION RfD[2] (mg/kg-day) | STUDY TYPE | CONFIDENCE LEVEL | CRITICAL EFFECT | TEST ANIMAL | UNCERTAINTY FACTOR | SOURCE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Endrin | P | ND | ND | ND | ND | | | | | | |
| Endrin aldehyde | P | ND | ND | ND | ND | | | | | | |
| Endrin ketone | P | ND | ND | ND | ND | | | | | | |
| Heptachlor | P | 7.0E-04 | ND | ND | ND | | | | | | MADEP |
| Heptachlor Epoxide | P | 7.0E-04 ++ | ND | ND | ND | | | | | | MADEP |
| Lindane (gamma-BHC) | P | 7.0E-04 | ND | ND | ND | | | | | | ATC |
| Methoxychlor | P | ND | ND | ND | ND | | | | | | |
| Polychlorinated Biphenyls (PCBs) | P | 2.0E-05 | ND | ND | ND | | | | | | MADEP |
| Toxaphene | P | ND | ND | ND | ND | | | | | | |
| VOLATILES | | | | | | | | | | | |
| 1,1,1-Trichloroethane | V | 1.0E+00 | ND | ND | ND | | | | | | MADEP |
| 1,1,2,2-Tetrachloroethane | V | 9.3E-02 | ND | ND | ND | | | | | | MADEP |
| 1,1,2-Trichloroethane | V | 7.4E-02 | ND | ND | ND | | | | | | MADEP |
| 1,1-Dichloroethane | V | 5.0E-01 | 5.0E+00 | 1.0E-01 [3] | 1.0E+00 [3] | Inhalation | Low | Kidney damage | Cat | 1,000 | HEAST[3] |
| 1,1-Dichloroethene | V | 5.0E-02 | ND | ND | ND | | | | | | MADEP |
| 1,2-Dichloroethane | V | 5.5E-02 | ND | ND | ND | | | | | | MADEP |
| 1,2-Dichloroethene (total) | V | 1.0E+00 | ND | ND | ND | | | | | | ATC |
| 1,2-Dichloroethene (cis) | V | 1.0E+00 | ND | ND | ND | | | | | | ATC |
| 1,2-Dichloroethene (trans) | V | 1.0E+00 | ND | ND | ND | | | | | | ATC |
| 1,2-Dichloropropane | V | 4.0E-03 | 1.3E-02 | 1.1E-03 | 3.7E-03 | Inhalation | Medium | Hyperplasia of the nasal mucosa | Rat | 300 H,A,S,L | IRIS |
| 1,3,5-Trimethylbenzene | V | 3.0E-01 --- | ND | ND | ND | | | | | | MADEP |
| 2,4,4-Trimethyl-1-pentene | V | 7.2E-01 | 7.2E-01 | 2.1E-01 | 2.1E-01 | | | | | | ABB-ES |
| 2,4,4-Trimethyl-2-pentene | V | 7.2E-01 | 7.2E-01 | 2.1E-01 | 2.1E-01 | | | | | | ABB-ES |
| 2-Butanone (Methyl Ethyl Ketone) | V | 1.0E+00 | 1.0E+00 | 2.9E-01 | 2.9E-01 | Inhalation | Low | Decreased fetal birth weight | Mouse | 1,000 H,A,D 3M | IRIS |
| 2-Hexanone | V | 5.0E-02 | ND | ND | ND | | | | | | ATC |
| 4-Methyl-2-pentanone (MIBK) | V | 8.0E-02 | 8.0E-01 | 2.3E-02 | 2.3E-01 | Inhalation | Low | Increased liver weight; kidney effects | Rat | 1,000 H,A,S | HEAST[3] |
| Acetone | V | 8.0E-01 | ND | ND | ND | | | | | | MADEP |
| Benzene | V | 9.0E-03 | 3.2E-02 | ND | ND | | | | | | MADEP |
| Bromodichloromethane | V | ND | ND | ND | ND | | | | | | |
| Bromoform | V | 6.6E-01 *** | ND | ND | ND | | | | | | MADEP |
| Carbon Disulfide | V | 7.0E-01 | 1.0E-02 | 2.0E-01 | 2.9E-03 | Inhalation | Medium | Peripheral nervous system dysfunction | Human | 30 H,D | IRIS |
| Carbon Tetrachloride | V | 4.3E-01 | ND | ND | ND | | | | | | MADEP |
| Chlorobenzene | V | 2.0E-02 | ND | 5.0E-03 [3] | ND | Inhalation | Low | Liver and kidney effects | Rat | 10,000 H,A,S,L | HEAST[3] |
| Chloroform | V | 6.6E-01 | ND | ND | ND | | | | | | MADEP |
| Chloromethane | V | 4.0E-01 | 4.0E-01 | ND | ND | Inhalation | ND | Decrease in weight gain | Mouse | 100 H,A | ATSDR, 1990 |
| Dibromochloromethane | V | ND | ND | ND | ND | | | | | | |
| Ethyl chloride (Chloroethane) | V | 1.0E+01 | 1.0E+01 | 2.9E+00 | 2.9E+00 | Inhalation | Medium | Delayed fetal ossification | Mouse | 300 H,A,D | IRIS |
| Ethylbenzene | V | 1.0E+00 | ND | 2.9E-01 | ND | Inhalation | Low | Developmental toxicity | Rat/Rabbit | 300 H,A,S | IRIS |
| Hexachlorobutadiene | V | ND | ND | ND | ND | | | | | | |
| Methylene Chloride (Dichloromethane) | V | 3.0E+00 | 3.0E+00 | 8.6E-01 | 8.6E-01 | Inhalation | Low | Liver toxicity | Rat | 100 H,A | HEAST[4] |
| Styrene | V | 1.0E+00 | 3.0E+00 | 2.9E-01 | 8.6E-01 | Inhalation | Medium | CNS effects | Human | 30 H,D,S | IRIS |
| Tetrachloroethene | V | 4.6E+00 | ND | ND | ND | | | | | | MADEP |
| Toluene | V | 4.0E-01 | ND | 1.1E-01 | ND | Inhalation | Medium | Neurological effects | Human | 300 H,L,D | IRIS |
| Trichloroethene | V | 1.8E-01 | ND | ND | ND | | | | | | MADEP |
| Vinyl Acetate | V | 2.0E-01 | 2.0E-01 | 5.7E-02 | 5.7E-02 | Inhalation | High | Nasal epithelial lesions | Rat/Mouse | 30 H,A | IRIS |
| Vinyl Chloride | V | 1.7E-03 | ND | ND | ND | | | | | | MADEP |
| Xylenes (total) | V | 3.0E-01 | ND | ND | ND | | | | | | MADEP |

NOTES:
ND - No data available
W - RfD withdrawn from IRIS/HEAST
mg - milligram
kg - kilogram
µg - microgram
DW - Drinking Water
IRIS - Integrated Risk Information System
HEAST - Health Effects Assessment Summary Tables
ATSDR - Agency for Toxic Substances Disease Registry (Toxicological Profiles; chemical-specific)
MADEP - Massachusetts Department of Environmental Protection
"Background Documentation for the Development of the MCP Numerical Standards" April, 1994
ATC - Ambient Threshold Concentration. Calculated from Threshold Effects Exposure Limits (TELs)

[1] Source of all subchronic RfCs is HEAST (1995)
[2] - RfD calculated from RfC as follows:
RfD (mg/kg-d) = RfC (mg/m[3])/ 70 kg x 20 m[3]/d
[3] - HEAST Table 2: Alternate Methods;
"RfC values derived from methodology not current with interim methodology used by RfD/RfC Work Group".
[4] - HEAST Table 1: Subchronic and Chronic Toxicity
[5] - There is a National Ambient Air Quality Standard for lead of 1.5 µg/m[3] averaged over three months
*Value for napthalene is used as surrogate for PAHs without assigned RfDs
-- Value for bis(2-ethylhexyl)phthalate used as surrogate
--- Value for xylenes used as surrogate

TABLE A4-4
INHALATION DOSE-RESPONSE DATA
FOR NONCARCINOGENIC EFFECTS

Olin Corporation
Wilmington, MA Facility

| COMPOUND | CHEMICAL GROUP | CHRONIC INHALATION RfC (mg/m3) | SUBCHRONIC(1) INHALATION RfC (mg/m3) | CHRONIC INHALATION RfD(2) (mg/kg-day) | SUBCHRONIC INHALATION RfD(2) (mg/kg-day) | STUDY TYPE | CONFIDENCE LEVEL | CRITICAL EFFECT | TEST ANIMAL | UNCERTAINTY FACTOR | SOURCE |
|---|---|---|---|---|---|---|---|---|---|---|---|

provided in "Massachusetts Threshold Effects Exposure Limits and Allowable Ambient Limits for Ambient Air" (December, 1995). ATC calculated as follows: TEL (ug/m3) x 5 x 0.001 mg/ug

SOURCES (in order used, per MADEP, 1995):
- IRIS as of 1/97; chronic RfDs
- HEAST, 1995 (including July update); chronic and subchronic RfDs
- MADEP, 1994; RfDs
- ATSDR (chemical-specific); Minimum Risk Levels (MRLs)
- MADEP TEL; ATCs

Uncertainty factors:
- H - variation in human sensitivity
- A - animal to human extrapolation
- S - extrapolation from subchronic to chronic NOAEL
- L - extrapolation from LOAEL to NOAEL
- N - NOEL not attained
- D - Lack of supporting data
- M - additional modifying factor

Chemical Group:
- A - Acid extractable
- B - Base neutral extractable
- I/M - Inorganic/Metal
- P - Pesticide
- V - Volatile
- W - Waste
- X - Other

* Value for PCBs used as surrogate
** Value for gamma-BHC used as surrogate
*** Value for chloroform used as surrogate
\+ Value for 1,2,4-trichlorobenzene used as surrogate
\+ + Value for heptachlor used as surrogate
\+ + + Value for 4-methylphenol used as surrogate
° Value for chlordane used for alpha- and gamma- isomers.
°° Value for 1,2-dichlorobenzene used as surrogate
°°° Value for 2-nitroaniline used as surrogate

# DEVELOPMENT OF A GROUNDWATER CONCENTRATION LIMIT FOR DIISOBUTYLENE

Prepared for:

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Project Number 6292-00

July 1990

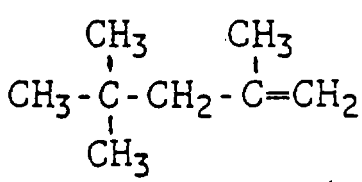
## INTRODUCTION

Olin Corporation (Olin) is in the process of evaluating site remediation options at a former operating plant in Wilmington, Massachusetts. The remediation will be in accordance with the Massachusetts Contingency Plan (MCP) which requires that clean-up levels be established on a health basis.

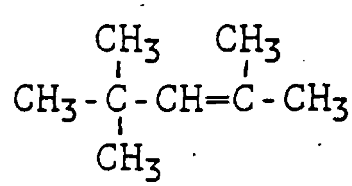
Diisobutylene, which is a groundwater contaminant at the site, has no health-based concentration limit. Olin has received a Draft Groundwater Discharge Permit which is set at the detection limit of 10 parts per billion (ppb). To meet the MCP requirement, we have derived a health-based concentration limit for diisobutylene based on available toxicity information. To derive the concentration limit, we calculated an RfD from animal data. Then we compared this value with the RfD from a structurally related compound and also with a calculated exposure from a worker guideline. Our concentration value was the most health protective of the three that might be estimated from these different approaches. Our rationale for the development of the concentration limit is presented below.

## TOXICITY OF DIISOBUTYLENE

Diisobutylene is an isomeric mixture of alpha-diisobutylene (2,4,4-trimethylpentene-1) and beta-diisobutylene (2,4,4-trimethylpentene-2). The structures of these two compounds are outlined below.



**alpha-diisobutylene**



**beta-diisobutylene**

The toxicity of diisobutylene has not been well-studied and is therefore not available in the general literature. However, we were able to obtain toxicity information from Texas Petrochemicals, Dow Chemical, and Dupont. The information we obtained consists of acute and subacute toxicity tests as well as skin and eye irritation and sensitization studies.

The $LD_{50}$ test is usually the first test performed with a new chemical. It is the statistically derived single dosage of a substance that can be expected to cause death in 50 percent of the animals (Klassen et al., 1986). Two oral $LD_{50}$ values have been reported for diisobutylene. Dow Chemical reported an $LD_{50}$ of greater than 10 g/kg in guinea pigs. Texas Petrochemicals reported an $LD_{50}$ of greater than 2.5 g/kg in rats. No additional acute toxicity information was available. Based on a typical toxicity rating scale, diisobutylene would be classified as slightly toxic in humans (Klassen et al., 1986). A toxicity rating chart is provided in the following text (Table 1).

TABLE 1

TOXICITY RATING CHART

| | PROBABLE ORAL LETHAL DOSE FOR HUMANS | |
|---|---|---|
| TOXICITY RATING OR CLASS | Dosage | For Average Adult |
| Practically nontoxic | > 15 g/kg | More than 1 quart |
| Slightly toxic | 5-15 g/kg | Between pint and quart |
| Moderately toxic | 0.5-5 g/kg | Between ounce and pint |
| Very toxic | 50-500 mg/kg | Between teaspoonful and ounce |
| Extremely toxic | 5-50 mg/kg | Between 7 drops and teaspoonful |
| Supertoxic | < 5 mg/kg | A taste (less than 7 drops) |

Source: Klassen et al., 1986.

In a subacute toxicity study, rats were administered doses of 0.1 ml/day (288 mg/kg) for two weeks. In one of the 10 rats, slight variations were noted in the nuclei of the liver cells. No other microscopic pathology was noted. There were no deaths or gross pathology (Dupont, 1978).

Dermal studies were conducted in humans and animals. When undiluted diisobutylene was applied to the skin of 200 human subjects, a burning sensation was noted in one subject after two hours of contact. No irritation was reported in any subject after 24 hours (Dupont, 1978).

On the skin of rabbits, diisobutylene produced slight to moderate irritation. No skin irritation was observed when diisobutylene was applied undiluted to the skin of guinea pigs. A slight to very slight irritation was seen in three of 10 animals in a sensitization test (Dupont, 1978). A 3 percent solution of diisobutylene in dimethyl phthalate did not cause any irritation when tested on the intact shaved skin of guinea pigs. In another study in which diisobutylene was prepared in a similar manner, no evidence of allergic contact dermatitis was observed. The test solution was applied to the abraded skin of guinea pigs three times a week for three weeks followed by a rest period of two weeks and then a challenge test on intact and abraded skin.

Instillation of diisobutylene into rabbit eyes produced conjunctival irritation but no corneal injury (PetroTex, 1978).

In one mutagenicity study, diisobutylene produced very low activity in Salmonella typhimurium TA 100 (Henschler, 1977). No information was found regarding carcinogenesis, developmental and reproductive toxicity or metabolism and there are no industrial reports of human exposure.

According to a Texas Petrochemicals Material Safety Data Sheet, skin and eye contact may cause irritation. Inhalation of high concentrations may cause irritation of the respiratory tract and may cause narcosis. If ingested, diisobutylene may cause gastric irritation and nausea and vomiting (Texas Petrochemicals, 1986).

## CALCULATION OF THE REFERENCE DOSE (RfD)

The Reference Dose (RfD) is a toxicity value based on noncarcinogenic toxic effects. An RfD is defined as an estimate of a daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of adverse effects during a lifetime. Reference doses are specifically developed to be protective for long-term exposure to a compound. In order to calculate an RfD, the critical study and critical toxic effect must first be identified. For the purposes of calculating the RfD, the critical study was the two week oral rat study described above in which ten animals were administered an oral dose of 288 mg/kg/day (Dupont, 1978). The critical effect was slight variations in the nuclei of liver cells in one rat. Therefore, we used 288 mg/kg/day as the Lowest Observable Adverse Effect Level (LOAEL). The LOAEL was adjusted to reflect that diisobutylene was administered on five out of seven days per week.

$$288 \text{ mg/kg/day} \times 5/7 = 205 \text{ mg/kg/day}$$

The traditional approach for establishing safe levels for chemicals to which humans may be exposed is to reduce the LOAEL by application of uncertainty factors. Uncertainty factors generally consist of multiples of 10, with each factor representing an area of uncertainty (USEPA, 1989). Uncertainty factors of 10 were applied to the LOAEL for each of the following areas: animal to human extrapolation, variation in human sensitivity, and the use of an LOAEL instead of a No Observable Adverse Effect Level (NOAEL), resulting in a total uncertainty factor of 1000. Therefore, the RfD can be calculated as follows:

$$\frac{205 \text{ mg/kg/day}}{1000} = 0.205 \text{ mg/kg/day}$$

This RfD is a conservative dose. In comparison, if we used the Recommended Workplace Environmental Exposure Level (WEEL) of 600 ppm (2748 $mg/m^3$) as the basis of the RfD, the RfD would be two orders of magnitude higher. This calculation is shown below.

Assuming an inhalation rate of 10 $mg/m^3$ per workday,

$$2748 \text{ mg/m}^3 \times 10 \text{ m}^3\text{/day} = 27{,}480 \text{ mg/day}$$

If the average adult weighs 70 kg and an uncertainty factor of 10 is applied for variation in human sensitivity,

$$\frac{27,480 \text{ mg/day}}{70 \text{ kg} \times 10} = 39.3 \text{ mg/kg/day}$$

Because this is a less conservative value, it was not used as the RfD.

CALCULATION OF THE GROUNDWATER CONCENTRATION LIMIT

The first step in the development of a concentration limit is to calculate the Chronic Daily Intake (CDI). The CDI for diisobutylene is calculated by multiplying the RfD by the Target Hazard Index. In this case, the Target Hazard Index is 1. This is the level at which noncarcinogens are not expected to exert toxic effects. Therefore, the CDI will be the same as the RfD (0.205 mg/kg/day).

The concentration limit is then determined by dividing the CDI by the Human Intake Factor.

$$\text{Concentration Limit} = \frac{\text{CDI (mg/kg/day)}}{\text{Human Intake Factor (L/kg/day)}}$$

The Human Intake Factor is derived by dividing the amount of water consumed per day by the average adult body weight. According to USEPA (1989), the average adult weighs 70 kg and consumes 2 liters of water per day. The absorption of diisobutylene from water must also be considered. We have conservatively assumed that absorption will be 100%. Therefore,

$$\text{Human Intake Factor} = \frac{2 \text{ liters/day}}{70 \text{ kg}} \times 100\%$$

$$= 0.029 \text{ L/kg/day}$$

In applying these equations to diisobutylene,

$$\text{Concentration Limit} = \frac{0.205 \text{ mg/kg/day}}{0.029 \text{ L/kg/day}}$$

$$= 7.1 \text{ mg/L}$$

The calculated health based concentration limit for diisobutylene is 7.1 mg/L. When compared to structurally similar compounds and their metabolic pathways, this concentration limit is reasonable and conservative.

## STRUCTURE ACTIVITY RELATIONSHIPS

Structure Activity Relationships (SAR) can be used to predict toxicologic activity based on the analysis of chemical structure. Chemical compounds with structures similar to diisobutylene were used to provide supporting toxicity information.

Diisobutylene is an eight-carbon branched-chain alkene. Isooctane (2,2,4- or 2,3,4-trimethylpentane) is an eight-carbon alkane with a similar carbon skeleton. Little published toxicity information is available on isooctane. Most of the toxicity studies were conducted by the inhalation route. Inhalation of isooctane is known to cause a moderate toxic hazard. High concentrations can cause narcosis. No oral toxicity values are available.

Octane and octene are eight-carbon straight-chain compounds. As with isooctane, little information is available on octene. Octane has been better studied but most of the exposures have been by the inhalation route.

None of these eight-carbon compounds has drinking water criteria or standards which can be compared to the diisobutylene concentration limit which we developed. N-hexane is the compound with an existing drinking water criterion which has the closest structural similarity to diisobutylene. Therefore, n-hexane will be the basis of comparison for the diisobutylene concentration limit.

## COMPARISON OF DIISOBUTYLENE AND N-HEXANE CRITERIA

The USEPA has developed a lifetime drinking water Health Advisory (HAs) for n-hexane. Health Advisories are not legally enforceable federal standards. They are developed from data describing noncarcinogenic endpoints of toxicity. The lifetime HA assumes the ingestion of 2 liters of contaminated drinking water per day by a 70-kg adult. They are derived in the same manner in which the diisobutylene concentration limit was derived. The lifetime HA for n-hexane is 10 mg/L.

The HA for n-hexane is based on its neurotoxicity in animals and humans. It is metabolized to 2,5-hexanedione which is believed to be the causative agent of most of the adverse neurological effects of n-hexane exposure. Isohexane, which has a branched chain structure similar to that of diisobutylene, is not believed to be as toxic as n-hexane because it would not follow the same metabolic pathway in the body.

In the following section, we will compare the metabolism of n-hexane to that of diisobutylene. The purpose of this comparison will be to show that the diisobutylene concentration limit of 7.1 mg/L is a conservative value when compared to the 10 mg/L value for n-hexane.

## METABOLISM OF DIISOBUTYLENE AND N-HEXANE

Diisobutylene is believed to undergo epoxidation to diisobutylene oxide. The epoxide ring would then be cleaved by epoxide hydrolase to form a diol. The diol is less chemically reactive than the epoxide and therefore less toxic (Klassen et al., 1986). The metabolic pathway is outlined in Figure 1.

Toxicity information was obtained for 2,3-diisobutylene oxide. In an oral rat study, the $LD_{50}$ was 4.9 g/kg indicating that metabolites of diisobutylene are less toxic than diisobutylene itself which has an $LD_{50}$ of 2.5 g/kg in rats (Union Carbide, 1958).

N-hexane is first oxidized to an alcohol (2-hexanol). It is further oxidized to 2,5-hexanediol and 2-hexanone which are ultimately transformed to 2,5-hexanedione, which is known chemically as a gamma-diketone metabolite. The metabolic pathway for n-hexane is outlined in Figure 2.

It has been well-documented that this metabolite is the cause of the toxic effects associated with n-hexane exposure (ACGIH, 1980; OSHA, 1989). In recent years, considerable evidence has accumulated that demonstrates that peripheral neuropathies are caused only by n-hexane and gamma-diketone metabolites (OSHA, 1989). The fact that isohexane, which has a branched-chain structure similar to diisobutylene, is not believed to form toxic gamma-diketone metabolites also suggests that diisobutylene is less toxic than the hexane isomers and that the concentration limit calculated here for diisobutylene is conservative.

SUMMARY

In summary, we calculated a concentration limit of 7.1 mg/L for diisobutylene based on a subacute oral study in rats. Appropriate safety factors were utilized. This concentration limit was consistent and health protective when compared to the USEPA Lifetime HA of 10 mg/L for n-hexane, a compound of much greater toxicity. In addition, the RfD of 0.205 mg/kg/day is more conservative by two orders of magnitude than if the WEEL were used as the basis for the RfD. This health-based concentration limit represents an increase of three orders of magnitude over the current clean-up level of 10 ug/L which is based on chemical detection limit alone.

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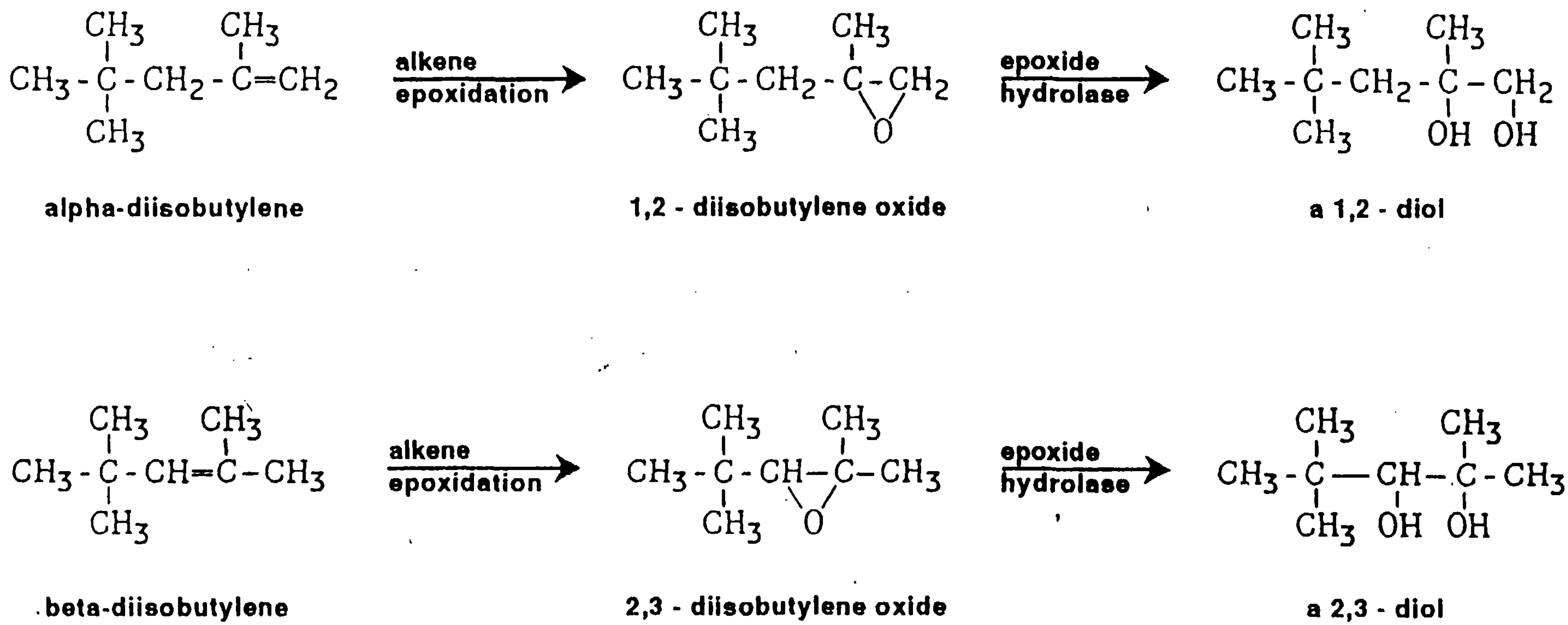


**FIGURE 1**
**Biotransformation of Alpha and Beta Diisobutylene**

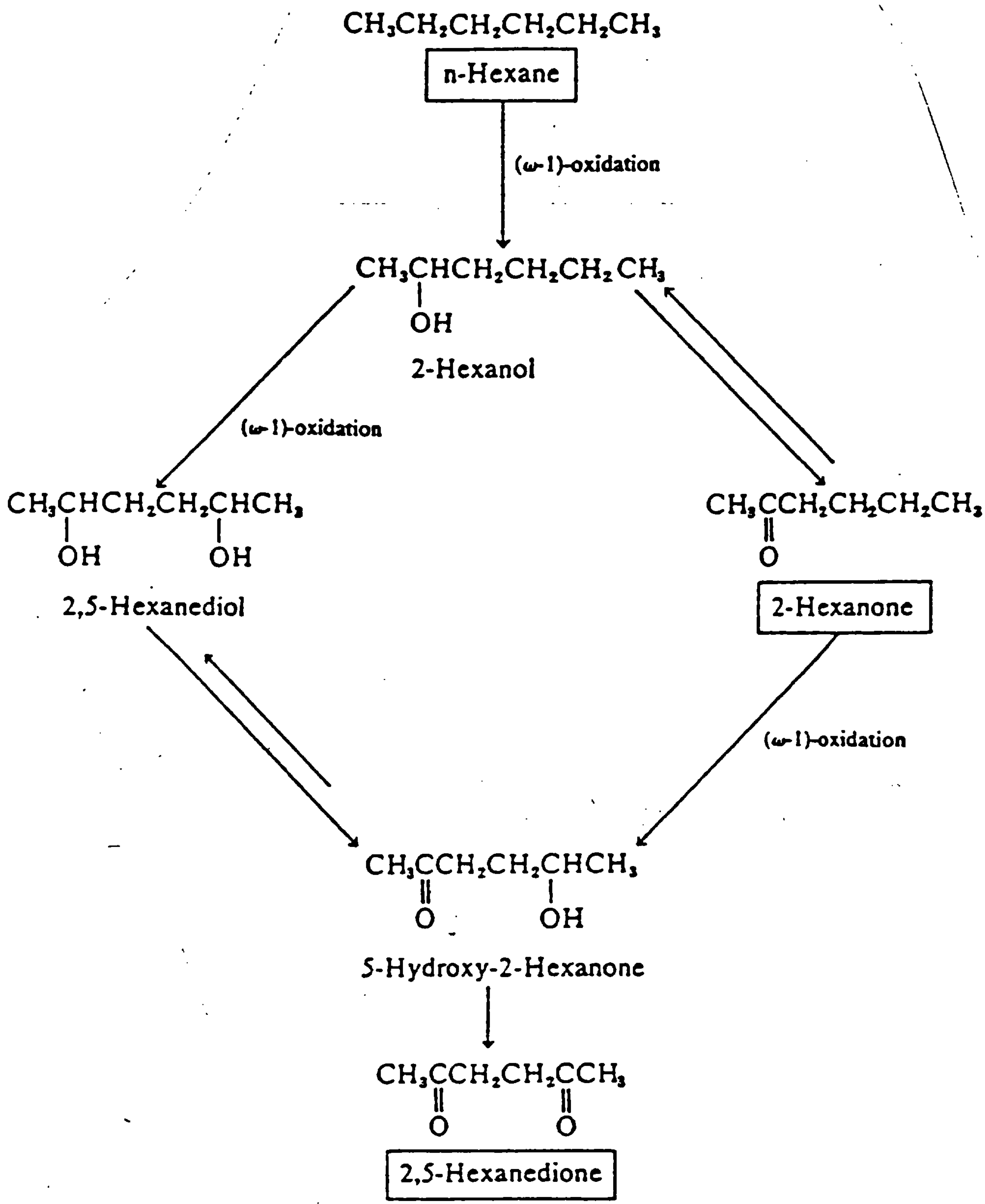


**FIGURE 2**
**Biotransformation of n-hexane**
**Source: Klassen et al., 1986**

# DERIVATION OF A CHRONIC ORAL REFERENCE DOSE FOR DINITROSOPENTAMETHYLENETETRAMINE (OPEX™)

**OLIN CORPORATION**
**51 EAMES STREET**
**WILMINGTON, MA**

**DEP RTN: 3-11816**

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*Prepared by:*

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Wakefield Service Center
Wakefield, Massachusetts

PN: 07331.09

JANUARY 1995

**DERIVATION OF A CHRONIC ORAL REFERENCE DOSE FOR DINITROSOPENTAMETHYLENETETRAMINE (OPEX™)**
**OLIN CORPORATION**
**51 EAMES STREET**
**WILMINGTON, MA**

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# DERIVATION OF A CHRONIC ORAL REFERENCE DOSE FOR DINITROSOPENTAMETHYLENETETRAMINE (OPEX™) OLIN CORPORATION 51 EAMES STREET WILMINGTON, MA

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**LISTING OF ABBREVIATIONS**

| | |
|---|---|
| i.p. | Intraperitoneal |
| i.v. | Intravenous |
| $LC_{50}$ | Concentration lethal to 50% of recipients |
| $LD_{50}$ | Dose lethal to 50% of recipients |
| LOAEL | Lowest-observed-adverse-effect level |
| MTD | Maximum tolerated dose |
| NOAEL | No-observed-adverse-effect level |
| RfD | Reference dose |
| s.c. | Subcutaneous |
| TLV | Threshold limit value |

# 1.0 PREFACE

This report describes the relevant toxicity studies used to derive a chronic oral RfD for dinitrosopentamethylenetetramine (DNPMT). The studies used in this report were partially identified through computerized literature searches. The automated data bases that were searched included CHEMLINE, TOXLINE, TOXLINE 65, TOXLIT, TOXLIT 65, CANCERLINE, RTECS, and IRIS. The on-line searches were extended as far back as the data bases would allow. The data bases were searched in November 1994 using the Chemical Abstract Service Registry Number (CASRN) and by chemical name and synonyms. Manual searches of *Current Contents, Health Effects Assessment Summary Tables*, bibliographies of relevant publications and secondary sources (International Agency for Research on Cancer [IARC] Monographs, National Institute for Occupational Safety and Health [NIOSH] documents, and U.S. EPA reports) were conducted to identify the most current literature (most recent six months) and key older studies (pre-1970). In addition, data from private toxicity studies conducted for Olin Corporation were supplied by Olin Corporation. All chronic, subchronic, and subacute toxicological studies in mammals using oral, dermal, inhalation and parenteral routes of exposure were reviewed for relevant information. Appropriate secondary sources were also reviewed. Every attempt was made to rely upon primary publications rather than summaries of data or abstracts contained in secondary sources.

## 2.0 INTRODUCTION

Dinitrosopentamethylenetetramine (DNPMT) (Chemical Abstract Service Registry Number [CASRN] 101-25-7), also known as 3,7-dinitroso-1,3,5,7-tetraazabicyclo(3.3.1)nonane, "Vulcacel" or Opex™, is used as a nitrogen-releasing expanding and blowing agent for the preparation of natural and synthetic rubbers, polyvinyl chloride plastisols and epoxy, polyester and silicone resins. Generally, DNPMT is a free-flowing powder of pale yellow needle-like crystals. The chemical formula of DNPMT is $C_5H_{10}N_6O_2$ and the molecular weight is 186.2. A threshold limit value (TLV) for DNPMT has not been established.

DNPMT is produced by the condensation of hexamethylenetetramine and sodium nitrite in the presence of acid, and may undergo thermal decomposition at temperatures in excess of 200°C liberating nitrogen oxides, formaldehyde and nitrosamines (Olin Corp., 1994). Exposing DNPMT to strong acids or oxidizing or reducing agents may also result in the break down of DNPMT.

No studies were located in the available literature which reported data on the absorption, distribution, metabolism or excretion of DNPMT in mammalian systems.

The rat oral $LD_{50}$ of DNPMT is 940 mg/kg (Desi et al., 1967), with a dermal $LD_{50}$ in rabbits exceeding 2 g/kg, and an inhalation $LC_{50}$ in rats greater than 200 mg/l (MB Research Labs, 1981a,b). Parenteral $LD_{50}$s in mice range from 120 mg/kg (i.v.) to 140 mg/kg (s.c.) (Ivan, 1965). The same author reported an i.v. $LD_{50}$ in rabbits of 130 mg/kg, and i.p. and s.c. $LD_{50}$s in rats of 200 mg/kg (Ivan, 1965). Following parenteral administration, lethality was preceded by motor agitation and clonic seizures. These acute data indicate that DNPMT has a very low order of acute toxicity by all routes of administration.

# 3.0 SUMMARY OF STUDIES

## 3.1 ORAL STUDIES

Limited chronic oral studies have been conducted on DNPMT. Hadidian et al. (1968) chronically administered DNPMT to male and female Fischer rats at dose levels of 9.0, 3.0, 0.9, 0.3, 0.09 or 0.03 mg/day in a study designed to assess the carcinogenicity of DNPMT. Dose levels were established during an eight-week subacute study aimed at determining the maximum tolerated dose (MTD). For the chronic study, dosing was conducted by gavage, 5 times per week for 1 year (260 individual doses) followed by an additional 6 months of observation without any further treatment. During the study period, animals were observed for signs of toxicity five times per week (at the time of dosing) and weighed every other week. At sacrifice, organs were weighed and prepared for histopathological examination. Survival and final body weights were consistent with control weights for all dosage groups. A generalized toxic enlargement of the liver was noted in a single animal in the 3.0 mg/day group. A fairly high incidence of uterine polyps occurred at the five lowest doses, but was not elevated above the occurrence of this same lesion in control females. No other treatment-related adverse effects were noted.

## 3.2 DERMAL STUDIES

No studies were located which assess the systemic toxicity of DNPMT following dermal exposure. Animals studies have been conducted to assess the potential of DNPMT to induce dermal sensitization. A negative Draize Test in albino rabbits has resulted in DNPMT being classified as a non-irritant (MB Research Labs, 1981c). A primary dermal irritation study was conducted in albino rabbits (MB Research Labs, 1981d). Animals were treated dermally with DNPMT at a dosage level of 2.0 g/rabbit. Mean scores for erythema and edema indicated that DNPMT is a non-irritant. In another study, guinea pigs were dosed with a 25% solution of DNPMT topically nine times over a three week period in an attempt to induce sensitization (MB Research Labs, 1981e). A challenge dose failed to elicit a significant response indicating that DNPMT is not a dermal sensitizer in guinea pigs.

### 3.3 INHALATION STUDIES

No studies were located which examined the toxicity of DNPMT by the inhalation route.

### 3.4 PARENTERAL STUDIES

In a study to assess the carcinogenicity of DNPMT, CB rats were intraperitoneally injected with weekly doses of 25 mg for 6 months (Boyland et al., 1968). Data presented indicate that the single dose level tested did not affect longevity. No other information regarding toxic effects was provided.

### 3.5 MUTAGENICITY AND CARCINOGENICITY

Mutagenicity studies have been conducted with DNPMT in a variety of short term assay systems using *S. typhimurium*, *S. cerevisiae*, *B. subtilis* and *E. coli*. All microbial results suggest that DNPMT is not mutagenic. Likewise, tests in mammalian systems have indicated the DNPMT is not mutagenic (RTECS, 1994).

Bioassays examining the carcinogenicity of DNPMT were located in the available literature. A single gavage dose of 90 mg/animal to female Sprague-Dawley rats did not induce mammary tumors after a six-month observation period (Griswold et al., 1966). Mortality was significantly increased at three and six-months after dosing, compared to control animals.
No tumors were observed in male and female Fischer rats administered 9 mg DNPMT/animal by gavage 5 days per week for 52 weeks and observed for an additional 6 months (Weisburger et al., 1966). Likewise, Hadidian et al. (1968) observed no significant dose-related incidence of tumors in male and female Fischer rats administered gavage doses of DNPMT ranging from 9 mg/day to 0.03 mg/day, five days per week, for one year, and observed for a further 6 months.

The administration of DNPMT by intraperitoneal injection did not result in a significant increase in tumors in CB rats at a dosage level of 25 mg/week (Boyland et al., 1968). Animals were dosed for 26 weeks and observed for up to two years prior to sacrifice.

DNPMT has been evaluated by the International Agency for Research on Cancer (IARC). It has been classified into IARC Group 3 (not classifiable as to carcinogenicity) based on insufficient animal data and no human data (IARC, 1976).

## 4.0 DERIVATION OF A CHRONIC ORAL RfD

When evaluating studies to serve as the basis for the derivation of a chronic oral RfD, oral toxicity studies would be considered the most appropriate. Inhalation, dermal and parenteral studies may also be considered if oral studies are not available or are of unacceptable quality.

Table 1 provides a summary of the appropriate oral studies evaluated for DNPMT. A single oral study was located which examined the toxicity of DNPMT following oral administration (Hadidian et al., 1968). Hadidian et al. (1968) chronically administered DNPMT to male and female Fischer rats by gavage, 5 days per week for 52 weeks. A level of 0.9 mg/day resulted in no adverse effects while a level of 3 mg/day produced signs of toxic enlargement of the liver in a single animal. Therefore, a NOAEL of 0.9 mg/day and a LOAEL of 3.0 mg/day can be established from these data.

None of the dermal or parenteral studies located during this review were determined to be appropriate for extrapolation to an oral RfD. This decision was based on the relevance of the endpoints examined (dermal sensitization and mortality) and the less than chronic duration of the studies.

The derivation of the chronic oral RfD from the chronic NOAEL of 0.9 mg/day, 5 days per week, involves the adjustment of the dose for continuous daily exposure and conversion of the daily gavage dose to an administered dose in mg/kg/day. The NOAEL of 0.9 mg/day (5 days per week) adjusts to a continuous daily dose of 0.64 mg/day. This conversion to an administered dose in mg/kg/day requires that an assumption be made concerning animal body weights which were not explicitly stated in the study. Initial and final body weights (0.065 kg - 0.412 kg) were supplied by Hadidian et al. (1968), however, this data can not be used to derive an average body weight for the duration of the study. The average chronic body weight of male Fischer rats from U.S. EPA (1988) was used to approximate the average body weight over the study period (0.38 kg). The male body weight was selected in the calculation since its use resulted in the calculation of a more conservative average daily dose. The use of this assumed body weight results in the calculation of an average daily does of 1.7 mg/kg/day. This estimated daily dose was further adjusted by the application of two 10-fold uncertainty factors to account for extrapolation from rodents to humans and the protection of sensitive subpopulations. These adjustments result in a chronic oral RfD of 0.017 mg/kg/day. A summary of the RfD derivation is provided in Table 2. Reference Papers are included in Appendix A.

Table 1. Oral Chronic/Subchronic Toxicity for Dinitrosopentamethylenetetramine

| Species/ Strain | Sex/ Number | Exposure | Effect | Reference |
|---|---|---|---|---|
| Rat/Fischer | F/15<br>M/15 | 3.0 mg/day; 5 days/week for 52 weeks by gavage | Enlarged liver | Hadidian et al., 1968 |
| Rat/Fischer | F/3<br>M/3 | 0.9 mg/day; 5 days/week for 52 weeks by gavage | No adverse effects | Hadidian et al., 1968 |

**Table 2**
**Summary of RfD Derivation**
**DINITROSOPENTAMETHYLENETETRAMINE**
**(CASRN 101-25-7)**

| | |
|---|---|
| Route: | Oral/gavage |
| Species/sex: | Fischer rat/male |
| Body Weight[1]: | 0.38 kg |
| Study dose: | 9.0, 3.0, 0.9, 0.3, 0.09 or 0.03 mg/day; 5 days per week |
| Duration: | 52 weeks |
| Effect: | Liver enlargement |
| NOAEL: | 0.9 mg/day |
| Daily Dose: | 1.7 mg/kg/day |
| Chronic Oral RfD[2]: | 0.017 mg/kg/day |
| Reference: | Hadidian et al., 1968 |

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[1] From U.S. EPA, 1988.
[2] Includes the application of two uncertainty factors.

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MB Research Laboratories, Inc. 1981d. Primary Dermal Irritation in Albino Rabbits (Opex 100; Dinitrosopentamethylenetetramine). Prepared for Olin Corporation, New Haven, CT.

MB Research Laboratories, Inc. 1981e. Guinea Pig Sensitization (Buehler) (Opex 100; Dinitrosopentamethylenetetramine). Prepared for Olin Corporation, New Haven, CT.

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# DERIVATION OF A CHRONIC ORAL REFERENCE DOSE FOR AZODICARBONAMIDE (KEMPORE™)

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## WILMINGTON, MA

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**DERIVATION OF A CHRONIC ORAL REFERENCE DOSE FOR AZODICARBONAMIDE (KEMPORE™) OLIN CORPORATION 51 EAMES STREET WILMINGTON, MA**

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**LISTING OF ABBREVIATIONS**

| | |
|---|---|
| $LC_{50}$ | Concentration lethal to 50% of recipients |
| $LD_{50}$ | Dose lethal to 50% of recipients |
| LOAEL | Lowest-observed-adverse-effect level |
| NOAEL | No-observed-adverse-effect level |
| RfD | Reference dose |
| TLV | Threshold limit value |

# 1.0 PREFACE

This report describes the relevant toxicity studies used to derive a chronic oral RfD for azodicarbonamide (ADA). The studies used in this report were partially identified through computerized literature searches. The automated data bases that were searched included CHEMLINE, TOXLINE, TOXLINE 65, TOXLIT, TOXLIT 65, CANCERLINE, RTECS, and IRIS. The on-line searches were extended as far back as the data bases would allow. The data bases were searched in November 1994 using the Chemical Abstract Service Registry Number (CASRN) and by chemical name and synonyms. Manual searches of *Current Contents, Health Effects Assessment Summary Tables*, bibliographies of relevant publications and secondary sources (International Agency for Research on Cancer [IARC] Monographs, National Institute for Occupational Safety and Health [NIOSH] documents, and U.S. EPA reports) were conducted to identify the most current literature (most recent six months) and key older studies (pre-1970). In addition, data from private toxicity studies conducted for Olin Corporation were supplied by Olin Corporation. All chronic, subchronic, and subacute toxicological studies in mammals using oral, dermal, inhalation and parenteral routes of exposure were reviewed for relevant information. Appropriate secondary sources were also reviewed. Every attempt was made to rely upon primary publications rather than summaries of data or abstracts contained in secondary sources.

# 2.0 INTRODUCTION

Azodicarbonamide (ADA) (Chemical Abstract Service Registry Number [CASRN] 123-77-3), also known as 1,1'-azobisformamide or Kempore™, is an oxidant used as a flour-maturing and bleaching agent. ADA was approved by the FDA in 1962 for use in baked goods at treatment levels of up to 45 parts per million (ppm). It is also widely used as an expanding and blowing agent for thermoplastic resins and some rubbers. Generally, ADA is a fine yellow powder, but may also have an orange crystalline appearance. The chemical formula of ADA is $C_2H_4N_4O_2$ and the molecular weight is 116.08. A TLV for ADA has not been established.

ADA is produced by the condensation of urea and hydrazine, and undergoes rapid thermal decomposition in aqueous media at temperatures in excess of 180°C liberating ammonia, nitrogen and carbon dioxide gases, and producing biurea (1-carbamylsemicarbazide), urazol and cyanuric acid (Herweh and Fantazier, 1974). Neutral aqueous hydrolysis is less rapid below 100°C, but increases in alkaline pH environments.

Available evidence suggests that ingested ADA is rapidly converted to the inert compound, biurea, under physiological conditions (Mewhinney et al., 1987). In this study, rats were administered $^{14}$C-labeled ADA by gavage at a dose of 0.1 mg and monitored in metabolism cages for 72 hours. All radioactivity in urine, feces and blood was associated with the metabolite biurea. No evidence was found of ADA or any other potential biotransformation products. A suggested biotransformation pathway involves the reduction of ADA by glutathione in biological fluids and tissues to biurea. These data are supported by inhalation studies in rats and mice (Medinsky et al., 1990) which demonstrated that, following exposure to airborne concentrations of up to 200 mg/m$^3$ for 13 weeks, only biurea could be detected in lung tissue. Oral absorption efficiency was estimated to be approximately 33% (Mewhinney et al., 1987), with excretion of absorbed material occurring primarily through urine.

The rat oral $LD_{50}$ of ADA is greater than 5 g/kg, with a dermal $LD_{50}$ in rabbits exceeding 2 g/kg, and an inhalation $LC_{50}$ in rats greater than 200 mg/l (MB Research Labs, 1982a,b,c). These acute data indicate that ADA has a very low order of acute toxicity by all routes of administration.

# 3.0 SUMMARY OF STUDIES

## 3.1 ORAL STUDIES

Because ADA is used as a flour-maturing agent and is quantitatively reduced to biurea during the dough-making process, chronic and subchronic toxicity tests have been conducted using ADA- or biurea-supplemented flour or bread. A two-year feeding study in albino rats and mongrel dogs was performed in which the principal ingredient in the diet was bread made either from flour treated with ADA at a level of 100 mg/kg, or from untreated flour to which biurea was added at levels of 750, 2370 or 7500 mg/kg after baking (Oser et al., 1965). In both species, observations were made of appearance, behavior, growth, food consumption, hematological, blood chemistry, and urine changes, survival and gross and microscopic pathology. In rats, evaluations were made of reproduction and lactation performance, with similar observations made in three descendant generations maintained on the same treatment protocol. No adverse dose-related effects were noted with respect to any of these criteria in either species.

In a second experiment (Oser et al., 1965), biurea was fed at 5% or 10% levels in a basal diet in both rats and dogs. Rats were treated for one year while dogs were treated for 11 months. The only effect noted in rats was decreased weight gain in males, corresponding to decreased food intake during the first twelve weeks of the study. Body weight in males returned to control levels by study termination. In dogs, evidence of renal pathology developed after 4 months of treatment. Survival was significantly decreased at both treatment levels. Histopathological examination revealed massive, multiple calculi in the kidneys, ureters and bladders with localized irritation and tissue pathology. These calculi were demonstrated analytically to consist primarily (80-100%) of biurea which was believed to have precipitated in tubular fluid due to the low water solubility of this compound.

In a subchronic study, Gafford et al. (1971) administered either ADA or biurea to Sprague-Dawley rats orally to assess the effects of treatment on thyroid function. ADA or biurea was mixed with rodent chow at levels of 1%, 5% or 10% ADA, or 5% or 10% biurea. Animals were serially sacrificed following 1 week (1% and 10% groups), 10 days (5% group) or 4 weeks (10% group) of treatment. Rats treated at dietary levels of 5% and 10% ADA for 10 days or 4 weeks had significantly lower thyroidal radioiodine uptakes than controls. Dietary levels of 1% ADA for 1 week did not result in any significant effects. Oral administration of biurea did not significantly alter thyroid function. All animals appeared clinically healthy throughout the study at all levels of ADA and biurea treatment.

## 3.2 DERMAL STUDIES

No studies were located which assess the systemic toxicity of ADA following dermal exposure. A case report (Yates and Dixon, 1989) was identified in which a 58-year-old textile worker with bilateral otitis externa was documented, through patch testing, to be allergic to ADA. During the course of work, he wore yellow foam earplugs which contained ADA as a component. The patients otitis externa resolved upon discontinuing the use of earplugs.

Animals studies have been conducted to assess the potential of ADA to induce dermal sensitization. A negative Draize Test in albino rabbits has resulted in ADA being classified as a non-irritant (MB Research Labs, 1982d). In another study, guinea pigs were treated for seven days with intradermal injections of ADA in the shoulder region and challenged 14 days later by the application of the test material to the flank under occlusive conditions (Toxicol-Sisa, 1982). There was no evidence that ADA acts as a dermal sensitizer in guinea pigs.

## 3.3 INHALATION STUDIES

Reports of airway constrictive responses in workers occupationally exposed to respirable dusts of ADA suggest that ADA might be an pulmonary sensitizer or irritant. Ferris et al. (1977) observed decreases in forced vital capacity and forced expiratory volume ($FEV_1$) of 10 workers engaged in the grinding of ADA. The authors noted that a few days of exposure appeared to be required for symptoms to develop.

Slovak (1981) performed a retrospective prevalence study of occupational asthma in a group of 151 workers who had been exposed to ADA dust. Twenty-eight (18.5%) workers without a previous history of asthma reported episodes of late onset asthma after exposure to ADA. Re-exposure caused repetition and worsening of symptoms. Removal from further exposure resulted in rapid cessation of symptoms without further recurrence. Continued exposure in sensitized individuals produced prolonged airway hyperreactivity to common environmental irritants.

Whitehead et al. (1987) examined a population of workers in a plastics molding facility where numerous complaints were apparently associated with the use of azodicarbonamide in injection molding of plastics. A strong association was noted with respiratory symptoms (nose and throat irritation, cough, wheezing, chest tightness and symptoms of chronic bronchitis) in workers during periods of azodicarbonamide use.

Normand et al. (1989) likewise reported cases of occupational asthma associated with exposure to ADA dust in the plastic industry. Controlled medical exposure to individuals believed to have been previously sensitized to ADA demonstrated decreased $FEV_1$ upon inhalation challenge with ADA.

Because of human case reports, inhalation studies were conducted to more fully characterize the toxicity of inhaled ADA. Two-week inhalation exposure of F344/N rats and $B6C3F_1$ mice to mean airborne concentrations ranging from 2.0 to 207 $mg/m^3$ demonstrated a decrease in terminal body weights and liver weights in male rats exposed to the highest concentration tested (Medinsky et al., 1990). No other clinical symptoms or histopathological effects were noted. In a companion 13-week study, animals were exposed to air levels of 50, 100 or 204 $mg/m^3$. Mice displayed depressed body weights at the two highest concentrations with no other clinical or histopathological effects noted. In rats exposed to the lowest concentration, pulmonary lesions (enlarged lymph nodes, perivascular cuffing with lymphocytes and type II cell hyperplasia) were present, suggestive of the presence of a viral infection. No clinical or histopathological effects were noted at the two highest concentrations in rats.

In a study specifically designed to assess pulmonary sensitization, Gerlach et al. (1989) exposed Hartley guinea pigs to aerosolized ADA at airborne levels of 51 or 200 $mg/m^3$ for 4 weeks. Three days following the termination of the 4-week exposure, specific airway conductance was measured during inhalation challenge of ADA. The 4-week exposure did not result in either specific or nonspecific airway sensitization, not did the exposure induce positive skin reactions, affect body weight or cause histopathological effects in the respiratory tract.

## 3.4 PARENTERAL STUDIES

Gafford et al. (1971) administered either ADA or biurea parenterally to Sprague-Dawley rats to assess the effects of treatment on thyroid function. ADA or biurea was suspended in propylene glycol and administered by intraperitoneal injection at doses of 200, 20 or 2 mg ADA/kg/day or 200 or 20 mg biurea/kg/day. All animals were sacrificed after 1 week of treatment. No significant alterations in thyroid function were noted. However, 5 of 8 high dose ADA-treated rats died during the course of the treatment, with death preceded by gross hematuria. The two lower doses produced no systemic sign of toxicity (anorexia, weight loss or gross hematuria). No clinical signs of toxicity were observed in biurea-treated animals.

## 3.5 MUTAGENICITY AND CARCINOGENICITY STUDIES

Mutagenicity studies have been conducted with ADA in a variety of short term assay systems. ADA has been demonstrated to be weakly mutagenic in Salmonella strain 1535 at concentrations of 500 $\mu$g (without metabolic activation) and 5,000 $\mu$g (with and without metabolic activation) per plate (Jacoby and Sullivan, 1981). A weakly positive response was also demonstrated in strain TA 100 with and without metabolic activation at a plate concentration of 5,000 $\mu$g.

Tests in mammalian systems have indicated that ADA is not mutagenic. In the CHO assay, ADA did not induce mutations either with or without metabolic activation at levels up to 300 $\mu$g/ml (Bioassay Systems Corp., 1982a). In assays for sister chromatid exchange (SCE), no evidence of SCEs were displayed at concentrations up to 300 $\mu$g/ml, with and without metabolic activation (Bioassay Systems Corp., 1982b).

Bioassays examining the carcinogenicity of ADA were not located in the available literature.

# 4.0 DERIVATION OF A CHRONIC ORAL RfD

When evaluating studies to serve as the basis for the derivation of a chronic oral RfD, oral toxicity studies would be considered the most appropriate. Inhalation, dermal and parenteral studies may also be considered if oral studies are not available or are of unacceptable quality. Studies conducted on the parent compound would be considered most relevant, however, toxicity data located on known metabolites may also be considered.

Table 1 provides a summary of the appropriate oral studies evaluated for ADA. Two oral studies were located which examined the toxicity of ADA following oral administration (Oser et al., 1965; Gafford et al., 1971). Gafford et al. (1971) subchronically administered ADA to rats in the diet. A dietary level of 1% resulted in no adverse effects while levels of 5% and 10% in the diet produced signs of diminished thyroid function. Therefore, a NOAEL of 1% and a LOAEL of 5% can be established from the data.

The study by Oser et al. (1965) evaluated the chronic toxicity of ADA which had been added to flour and baked into bread prior to administration to dogs and rats. The processing of flour into bread results in the efficient conversion of ADA to biurea, the single known biological metabolite of ADA. The NOAEL in both species was determined to be 100 ppm in the diet, the highest dose tested.

None of the dermal, inhalation or parenteral studies located during this review were determined to be appropriate for extrapolation to an oral RfD. This decision was based on the relevance of the endpoints examined (pulmonary or dermal sensitization), the form of the compound administered (biurea vs. ADA) and the lack of dose-response data available for human studies.

Of the two oral studies under consideration, the Gafford et al. (1971) study is selected as the most appropriate. Despite the brief duration of exposure (from 1-4 weeks), the compound was administered in parent form rather than as the metabolite biurea. This appears to be important since biurea, administered at 5% and 10% in the diet in the same study, failed to produce the thyroid effects noted following parent compound administration.

**Table 1. Oral Chronic/Subchronic Toxicity for Azodicarbonamide**

| Species/ Strain | Sex/ Number | Exposure | Effect | Reference |
|---|---|---|---|---|
| Rat/FDRL | F/25 M/25 | 100 mg/kg (processed into bread) in the diet for 2 years | No adverse effects | Oser et al., 1965 |
| Dog/mongrel | F/2 M/2 | 100 mg/kg (processed into bread) in the diet for 2 years | No adverse effects | Oser et al., 1965 |
| Rat/Sprague-Dawley | M/12 | 1% (10,000 mg/kg) in the diet for 1 week | No adverse effects | Gafford et al., 1971 |
| Rat/Sprague-Dawley | M/12 | 5% (50,000 mg/kg) or 10% (100,000 mg/kg) in the diet for 10 days or 4 weeks, respectively | Decreased thyroidal radioiodine uptakes | Gafford et al., 1971 |

The derivation of the chronic oral RfD from the subchronic NOAEL of 1% (10,000 mg/kg) in the diet involves the conversion of the dietary dose to an administered dose in mg/kg/day. This conversion requires that assumption be made concerning animal body weights and intake rates which were not explicitly stated in the study. Mean body weight on the day of sacrifice (0.2 kg) was supplied as well as a range of initial body weights (0.16-0.18 kg), which were used to derive a mean initial body weight (0.17 kg). The average of the two body weights (initial and final) are used to approximate the average body weight over the study period (0.185 kg). A food intake rate was selected (0.018 kg/day) from U.S. EPA (1988) which most closely matched the assumed average body weight (Fischer 344 male subchronic body weight; 0.18 kg). These two assumed parameters were used, in conjunction with the concentration of ADA in the diet (10,000 mg/kg) to derive an estimated daily dose of 973 mg/kg/day. This estimated daily dose was further adjusted by the application of three 10-fold uncertainty factors to account for the less than chronic study duration, extrapolation from rodents to humans and the protection of sensitive subpopulations. These adjustments result in a chronic oral RfD of 0.973 mg/kg/day. A summary of the RfD derivation is provided in Table 2. Reference papers are included in Appendix A.

**Table 2**
**Summary of RfD Derivation**

**AZODICARBONAMIDE**
**(CASRN 123-77-3)**

| | |
|---|---|
| Route: | Oral/diet |
| Species/sex: | Sprague-Dawley rat/male |
| Body Weight: | 0.185 kg |
| Intake Rate[1]: | 0.018 kg/day |
| Study dose: | 1% in the diet (10,000 mg/kg diet)<br>5% in the diet (50,000 mg/kg diet) |
| Duration: | 1-4 weeks |
| Effect: | Decreased thyroidal radioiodine uptake |
| NOAEL: | 10,000 mg/kg diet |
| Daily Dose: | 973 mg/kg/day |
| Chronic Oral RfD[2]: | 0.973 mg/kg/day Δ |
| Reference: | Gafford et al., 1971 |

[1] From U.S. EPA, 1988.
[2] Includes the application of three uncertainty factors.

NOAEL = $\frac{10{,}000\ mg}{kg} * \frac{0.018\ kg}{day} * \frac{1}{.185\ kg} * .001 =$

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Attachment

## Oral Toxicity Assessment for Cobalt

Cobalt has been found to stimulate the production of red blood cells in humans and, therefore, has been used as a treatment for anemia. In 12 anemic, anephric patients undergoing dialysis, treatment with 0.18 mg cobalt/kg/day as cobalt chloride for 12 weeks resulted in a significant rise in hemoglobin (Duckham and Lee, 1976). Taylor et al. (1977) reported similar effects in 8 anephric patients treated with 0.16-0.32 mg cobalt/kg/day as cobalt chloride for 12-32 weeks. In both studies, hemoglobin levels returned to pre-treatment levels following the cessation of treatment. Similar effects were reported in nonanemic humans and animals (Davis and Fields, 1958; Krasovskii and Fridlyand, 1971). Reversible polycythemia was reported in 6 normal male subjects following treatment with 1 mg cobalt/kg/day as cobalt chloride for 25 days (Davis and Fields, 1958). In normal rats, treatment with 0.5 mg cobalt/kg/day, but not 0.05 mg/kg/day, as cobalt chloride resulted in polycythemia and an increase in hemoglobin (Krasovskii and Fridlyand, 1971). An increase in hematocrit and hemoglobin levels was not observed, however, in pregnant women treated with 0.5-0.6 mg cobalt/kg/day for 90 days in an attempt to alleviate the anemia often found during pregnancy (Holly, 1955).

Much of the oral data in humans deals with the cardiomyopathy seen in people who drank large quantities of beer containing cobalt chloride (used to stabilize the foam) (Alexander, 1969, 1972; Morin et al., 1971). The people ingested 0.04-0.14 mg cobalt/kg/day (approximately 8-30 pints of beer daily) over a period of years (Alexander, 1969, 1972; Morin et al., 1971). The cardiomyopathy in the beer-drinkers, termed "beer-cobalt cardiomyopathy", was fatal to 43% of the subjects within several years, with approximately 18% of these deaths occurring within the first several days. The beer-cobalt cardiomyopathy appeared to be similar to alcoholic cardiomyopathy and beriberi, but the onset of the beer-cobalt cardiomyopathy was much more abrupt. The practice of adding cobalt to beer to stabilize the foam has been discontinued. It should be noted, however, that the cardiomyopathy may have also been due to the fact that the beer-drinkers had protein-poor diets and may have had prior cardiac and hepatic damage from alcohol abuse. Treatment of both pregnant and nonpregnant anemic patients with comparable or much higher doses of cobalt (0.09-1 mg cobalt/kg/day) did not result in effects on the heart (Duckham and Lee, 1976; Davis and Fields, 1958; Holly, 1955; Taylor et al., 1977).

Cobalt has been found to be a sensitizer in humans. Individuals are sensitized following dermal or inhalation exposure, but flares of dermatitis may be triggered following cobalt ingestion. One study was located that orally challenged cobalt-exposed workers in order to assess sensitization (Veien et al., 1987). In this study, several patients with eczema of the hands were challenged orally with 1 mg cobalt (0.014 mg cobalt/kg/day as cobalt sulfate) in tablet form once per week for 3 weeks and 28/47 patients had a flare of dermatitis following the oral challenge (Veien et al., 1987). Forty-seven patients had positive patch tests to cobalt (13 to cobalt alone and 34 to nickel and cobalt) and 7 of the 13 patients that patch tested positive to cobalt reacted to the oral challenge. Using both the oral challenge and dermal patch tests, it was determined that the cobalt allergy was systemically induced. The exposure levels associated with sensitization to cobalt following inhalation or dermal exposure were not established.

Interrelationships have been found to exist between cobalt and nickel sensitization (Bencko et al., 1983; Rystedt and Fisher, 1983; Veien et al., 1987). In guinea pigs, nickel and cobalt sensitization appear to be interrelated and mutually enhancing (Lammintausta et al., 1985). Therefore, it is possible that in people sensitized by nickel, exposure to cobalt may result in an allergic reaction. The elicitation of an allergic response in cobalt-sensitized workers was considered for the derivation of an oral RfD. An oral RfD was not derived because a NOAEL for the elicitation of the allergic response in humans was not defined and, because interrelationships exist between cobalt and nickel sensitization, people sensitized by nickel may have an allergic reaction following cobalt exposure. Consequently, it is impossible to certify that an RfD based on this effect would provide sufficient protection for sensitive individuals.

Three studies were located examining the developmental effects of orally administered cobalt (given as cobalt chloride) in rodents (Domingo et al., 1985; Paternain et al., 1988; Seidenberg et al., 1986). Domingo et al. (1985) treated pregnant female rats to 5.4 to 21.8 mg cobalt/kg/day from gestation day 14 through lactation day 21. Fetal effects included stunted growth of the pups at 5.4 mg cobalt/kg/day and decreased survival at 21.8 mg cobalt/kg/day. These effects occurred at levels that were maternally toxic (authors did not specify the effects), therefore, the effects may be a result of maternal toxicity and not cobalt treatment. No teratogenic effects were reported.

No significant effects on fetal growth or survival were found in rats exposed to 6.2 to 24.8 mg cobalt/kg/day during gestation days 6-15 (Paternain et al., 1988), although a nonsignificant increase in the incidence of stunted fetuses was found in the animals treated with 12.4 or 24.8 mg cobalt/kg/day. Maternal effects, however, including reduced body weight and food consumption and altered hematological parameters, were reported. No fetal effects were reported in mice exposed to 81.7 mg cobalt/kg/day during gestation days 8-12 (Seidenberg et al., 1986), but a significant decrease in maternal weight was found.

Several studies reported testicular degeneration and atrophy in rats exposed to 5.7 to 30.2 mg cobalt/kg/day as cobalt chloride for 2-3 months in the diet or in the drinking water (Corrier et al., 1985; Domingo et al., 1984; Mollenhauer et al., 1985; Nation et al., 1983; Pedigo et al., 1988).

Given the database, the most sensitive indicators of cobalt toxicity following oral exposure are the increase in hemoglobin in both humans and animals, and the elicitation of dermatitis in sensitized individuals.

An alternative approach was likewise evaluated based on the hematological effects of cobalt treatment (increase in hemoglobin) in anemic dialysis patients (Duckham and Lee, 1976). The results of this study are supported by a similar study in anephric patients (Taylor et al., 1977). Hematological effects of cobalt were also found in studies in normal humans (Davis and Fields, 1958) and rats (Krasovskii and Fridlyand, 1971) indicating that the effect is not limited to anephric individuals. The data of Davis and Fields (1958) reported hemoglobin increase of 6-11 % over "normal" in "normal" volunteers given 0.96 mg cobalt/kg/day as cobaltous chloride. However, the data of Duckham and Lee (1976) describes a case of refractory anemia in patients with chronic renal failure that upon treatment with 0.18 mg cobalt/kg/day for 12 weeks responded favorably. The patients hemoglobin levels were increased to levels at or near low "normal" clinical levels from levels clinically described as anemic. The anemia recurred following cessation of treatment. Thus, this effect of cobalt administration in the Duckham and Lee (1976) study (and likewise that of Taylor et al., 1977) cannot be termed adverse, but are actually clinically beneficial to patients with renal disease. Consequently, these data cannot be used to derive an oral RfD.

The only known nutritional, but vital function of cobalt is as a cofactor of vitamin $B_{12}$. In humans, vitamin $B_{12}$ is derived from bacterial synthesis and therefore, cobalt is essential for animal species, such as ruminants, that depend totally on their bacterial flora for vitamin $B_{12}$. There is no evidence that the intake of cobalt is ever limiting in the human diet, and therefore no RDA is deemed necessary for cobalt (NRC, 1989). It should be noted that the average daily intake of cobalt in humans ranges from approximately 0.002-0.008 mg cobalt/kg/day in adults (0.16-0.58 mg cobalt/day ÷ 70 kg; Tipton et al., 1966; Schroeder et al., 1967) and 0.01-0.06 mg cobalt/kg/day in children (0.3-1.77 mg cobalt/day ÷ 28 kg; NRC, 1989; Murthy et al., 1971). Murthy et al. (1971) indicated that the children in this study ranged in age from 9-12 years. Using the average weight of 28 kg for children aged 7-10 years (NRC, 1989), the average daily intake for the children in this study ranged from 0.01-0.06 mg/kg/day. If the default adult weight of 70 kg is used with the Murthy data, then the range of intake would be from 0.004-0.025 mg/kg/day.

The effects of chronic occupational exposure to cobalt on the respiratory system are well documented. Cobalt has been found to be the etiologic agent in hard metal disease. The observed effects include respiratory irritation, wheezing, asthma, pneumonia and fibrosis and have been found to occur at exposure levels ranging from 0.003 to 0.893 mg cobalt/$m^3$ over a period of 2-17 years (Davison et al., 1983; Demedts et al., 1984; Kusaka et al., 1986a,b; Raffn et al., 1988; Shirakawa et al., 1988; Sprince et al., 1988).

Studies have implicated cobalt as a sensitizer in humans. Although the minimum exposure level associated with cobalt sensitization has not been determined, work-related asthma was found in hard metal workers who were occupationally exposed (for greater than 3 years) to levels of cobalt ranging from 0.007 to 0.893 mg cobalt/$m^3$ (Shirakawa et al., 1988). Given the database, the most sensitive indicators of cobalt toxicity by inhalation exposure are the effects on the respiratory system in both humans and animals and allergic responses in cobalt-sensitized individuals.

The data described above does not identify a single study, animal or human, that could be used to properly derive an oral RfD. In unusual circumstances, i.e., excessive beer drinking or through occupational sensitization, cobalt has been shown to manifest toxicological symptomatology. However, these reports provide inadequate data on which to derive an RfD. Furthermore, use of inhalation data to derive an oral RfD is precluded due to portal of entry effects. It is apparent that the upper range of average intake for children (0.06 mg/kg/day) is below the levels of cobalt needed to induce polycythemia in both renally comprised patients (0.18 mg/kg/day) and normal patients (0.96 mg/kg/day).

Therefore, in lieu of an oral RfD for cobalt and given the ubiquitous nature of cobalt and the relatively well characterized intake of cobalt in food, it is recommended that the intake levels described above be used as guidance for oral exposure to cobalt.

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**TABLE A4-5**
**RELATIVE ABSORPTION FACTORS**
**FOR CARCINOGENIC EFFECTS**

**Olin Corporation**
**Wilmington, MA Facility**

| | | SITE OF EXPOSURE [a] | | | | | STUDY EXPOSURE ROUTE [a] | | | | | | RAF - CANCER | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ANALYTE | CHEMICAL TYPE | Soil Ingestion | Soil Dermal Contact | Water Ingestion | Water Dermal Contact | Produce Ingestion | Gavage | Drinking Water | Dietary (food) | Injection | Inhalation | Dermal Contact | Dose-response Study Type [b] | Soil Cancer Oral | Soil Cancer Dermal | Water Cancer Oral | Water Cancer Dermal | Produce Ingestion Oral | RAF Source [c] |
| **ACID EXTRACTABLE COMPOUNDS** | | | | | | | | | | | | | | | | | | | |
| 2,4,6-Trichlorophenol | A | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.26 | 1 | 1.05 | NA | MADEP, 1994 |
| 2,4-Dichlorophenol | A | | | | | | | | | | | | NA | | | | | | |
| 2,4-Dimethylphenol | A | | | | | | | | | | | | NA | | | | | | |
| 2,4-Dinitrophenol | A | | | | | | | | | | | | NA | | | | | | |
| 2-Chlorophenol | A | | | | | | | | | | | | NA | | | | | | |
| 2-Methylphenol (o-Cresol) | A | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | ND | NA | NA | NA | NA | NA | per MADEP, 1995 |
| 2-Nitrophenol | A | | | | | | | | | | | | NA | | | | | | |
| 4,6-Dinitro-2-methylphenol | A | | | | | | | | | | | | NA | | | | | | |
| 4-Chloro-3-methylphenol | A | | | | | | | | | | | | NA | | | | | | |
| 4-Methylphenol (p-Cresol) | A | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | ND | NA | NA | NA | NA | NA | per MADEP, 1995 |
| 4-Nitrophenol | A | | | | | | | | | | | | NA | | | | | | |
| Benzoic Acid | A | | | | | | | | | | | | NC | | | | | | |
| Phenol | A | | | | | | | | | | | | NC | | | | | | |
| **BASE NEUTRAL COMPOUNDS** | | | | | | | | | | | | | | | | | | | |
| 1,2,3-Trichlorobenzene | B | | | | | | | | | | | | NA | | | | | | |
| 1,2,4-Trichlorobenzene | B | | | | | | | | | | | | NC | | | | | | |
| 1,2-Dichlorobenzene | B | | | | | | | | | | | | NC | | | | | | |
| 1,3-Dichlorobenzene | B | | | | | | | | | | | | NC | | | | | | |
| 1,4-Dichlorobenzene | B, V | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | G | 1 | 0.1 | 1 | 1.10 | NA | MADEP, 1994 |
| 2,6-Dinitrotoluene | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 0.96 | 0.18 | 0.97 | 1.05 | 0.97 | per MADEP, 1995 |
| 2-Methylnaphthalene | B | | | | | | | | | | | | NA | | | | | | |
| 4-Bromophenyl-phenylether | B | | | | | | | | | | | | NA | | | | | | |
| 4-Chloroaniline | B | | | | | | | | | | | | NA | | | | | | |
| 4-Chlorophenyl-phenylether | B | | | | | | | | | | | | NA | | | | | | |
| 4-Nitroaniline | B | | | | | | | | | | | | NA | | | | | | |
| Acenaphthene | B | | | | | | | | | | | | NA | | | | | | |
| Acenaphthylene | B | | | | | | | | | | | | NC | | | | | | |
| Anthracene | B | | | | | | | | | | | | NC | | | | | | |
| Benzo(a)anthracene | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.2 | 1 | 1.05 | NA | MADEP, 1994 |
| Benzo(a)pyrene | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.2 | 1 | 1.05 | NA | MADEP, 1994 |
| Benzo(b)fluoranthene | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.2 | 1 | 1.05 | NA | MADEP, 1994 |
| Benzo(g,h,i)perylene | B | | | | | | | | | | | | NC | | | | | | |
| Benzo(k)fluoranthene | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.2 | 1 | 1.05 | NA | MADEP, 1994 |
| Benzyl Alcohol | B | | | | | | | | | | | | NA | | | | | | |
| Bis(2-ethylhexyl)phthalate (BEHP) | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.02 | 1 | 1.05 | NA | MADEP, 1994 |
| Bis(Chloromethyl)ether | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 0.96 | 0.18 | 0.97 | 1.05 | 0.97 | per MADEP, 1995 |
| Butylbenzylphthalate | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | ND | NA | NA | NA | NA | NA | per MADEP, 1995 |
| Chrysene | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.2 | 1 | 1.05 | NA | MADEP, 1994 |
| Di-n-butylphthalate | B | | | | | | | | | | | | NC | | | | | | |

**TABLE A4-5**
**RELATIVE ABSORPTION FACTORS**
**FOR CARCINOGENIC EFFECTS**

**Olin Corporation**
**Wilmington, MA Facility**

| ANALYTE | CHEMICAL TYPE | SITE OF EXPOSURE [a] Soil Ingestion | Soil Dermal Contact | Water Ingestion | Water Dermal Contact | Produce Ingestion | STUDY EXPOSURE ROUTE [a] Gavage | Drinking Water | Dietary (food) | Injection | Inhalation | Dermal Contact | RAF - CANCER Dose-response Study Type [b] | Soil Cancer Oral | Soil Cancer Dermal | Water Cancer Oral | Water Cancer Dermal | Produce Ingestion Oral | RAF Source [c] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Di-n-octylphthalate | B | | | | | | | | | | | | NA | | | | | | |
| Dibenzo(a,h)anthracene | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.09 | 1 | 1.05 | NA | MADEP, 1994 |
| Dibenzofuran | B | | | | | | | | | | | | NC | | | | | | |
| Diethylphthalate | B | | | | | | | | | | | | NC | | | | | | |
| Dimethylphthalate | B | | | | | | | | | | | | NC | | | | | | |
| Fluoranthene | B | | | | | | | | | | | | NC | | | | | | |
| Fluorene | B | | | | | | | | | | | | NC | | | | | | |
| Hexachlorobenzene | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.13 | 1 | 1.05 | NA | MADEP, 1994 |
| Indeno(1,2,3-cd)pyrene | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.2 | 1 | 1.05 | NA | MADEP, 1994 |
| Isophorone | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | G | 1.00 | 0.19 | 1.01 | 1.10 | 1.01 | per MADEP, 1995 |
| n-Nitrosodi-n-propylamine [d] | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | 1 | 0.95 | 1 | 1 | 0.14 | W | 0.91 | 0.17 | 0.92 | 1.00 | 0.95 | per MADEP, 1995 |
| n-Nitrosodiphenylamine [d] | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | 1 | 0.95 | 1 | 1 | 0.14 | W | 0.91 | 0.17 | 0.92 | 1.00 | 0.95 | per MADEP, 1995 |
| Naphthalene | B, V | | | | | | | | | | | | NC | | | | | | |
| Nitrobenzene | B | | | | | | | | | | | | NA | | | | | | |
| Phenanthrene | B | | | | | | | | | | | | NC | | | | | | |
| Pyrene | B | | | | | | | | | | | | NC | | | | | | |
| **INORGANICS/METALS** | | | | | | | | | | | | | | | | | | | |
| Aluminum | I/M | | | | | | | | | | | | NA | | | | | | |
| Antimony | I/M | | | | | | | | | | | | NA | | | | | | |
| Arsenic | I/M | 0.39 | 0.03 | 0.4 | 1 | 0.39 | NA | 0.55 | 0.21 | 1 | NA | 0.017 | W | 1 | 0.03 | 1 | 1.82 | NA | MADEP, 1994 |
| Barium | I/M | | | | | | | | | | | | NA | | | | | | |
| Beryllium | I/M | 0.39 | 0.03 | 0.4 | 1 | 0.39 | NA | 0.55 | 0.21 | 1 | NA | 0.017 | W | 1 | 0.03 | 1 | 1.82 | NA | MADEP, 1994 |
| Cadmium (food) | I/M | 0.39 | 0.03 | 0.4 | 1 | 0.39 | NA | 0.55 | 0.21 | 1 | NA | 0.017 | ND | NA | NA | NA | NA | NA | per MADEP, 1995 |
| Cadmium (water) | I/M | 0.39 | 0.03 | 0.4 | 1 | 0.39 | NA | 0.55 | 0.21 | 1 | NA | 0.017 | ND | NA | NA | NA | NA | NA | per MADEP, 1995 |
| Calcium | I/M | | | | | | | | | | | | NA | | | | | | |
| Chloride | I/M | | | | | | | | | | | | NA | | | | | | |
| Chromium III | I/M | | | | | | | | | | | | NA | | | | | | |
| Chromium VI | I/M | | | | | | | | | | | | NA | | | | | | |
| Cobalt (adult) | I/M | | | | | | | | | | | | NA | | | | | | |
| Cobalt (child) | I/M | | | | | | | | | | | | NA | | | | | | |
| Copper | I/M | | | | | | | | | | | | NC | | | | | | |
| Cyanide | I/M | | | | | | | | | | | | NC | | | | | | |
| Iron | I/M | | | | | | | | | | | | NA | | | | | | |
| Lead | I/M | 0.39 | 0.03 | 0.4 | 1 | 0.39 | NA | 0.55 | 0.21 | 1 | NA | 0.017 | ND | NA | NA | NA | NA | NA | per MADEP, 1995 |
| Magnesium | I/M | | | | | | | | | | | | NA | | | | | | |
| Manganese (drinking water) | I/M | | | | | | | | | | | | NC | | | | | | |
| Manganese (food) | I/M | | | | | | | | | | | | NC | | | | | | |
| Manganese (soil) | I/M | | | | | | | | | | | | NC | | | | | | |
| Mercury (as Mercuric chloride) | I/M | | | | | | | | | | | | NC | | | | | | |
| Nickel | I/M | | | | | | | | | | | | NA | | | | | | |

**TABLE A4-5**
**RELATIVE ABSORPTION FACTORS**
**FOR CARCINOGENIC EFFECTS**

**Olin Corporation**
**Wilmington, MA Facility**

| ANALYTE | CHEMICAL TYPE | SITE OF EXPOSURE [a] | | | | | STUDY EXPOSURE ROUTE [a] | | | | | | RAF - CANCER | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Soil Ingestion | Soil Dermal Contact | Water Ingestion | Water Dermal Contact | Produce Ingestion | Gavage | Drinking Water | Dietary (food) | Injection | Inhalation | Dermal Contact | Dose-response Study Type [b] | Soil Cancer Oral | Soil Cancer Dermal | Water Cancer Oral | Water Cancer Dermal | Produce Ingestion Oral | RAF Source [c] |
| Nitrate | I/M | | | | | | | | | | | | NA | | | | | | |
| Nitrite | I/M | | | | | | | | | | | | NA | | | | | | |
| Nitrogen, Ammonia | I/M | | | | | | | | | | | | NA | | | | | | |
| Potassium | I/M | | | | | | | | | | | | NA | | | | | | |
| Selenium | I/M | | | | | | | | | | | | NC | | | | | | |
| Silver | I/M | | | | | | | | | | | | NC | | | | | | |
| Sodium | I/M | | | | | | | | | | | | NA | | | | | | |
| Strontium | I/M | | | | | | | | | | | | NA | | | | | | |
| Sulfates as SO4 | I/M | | | | | | | | | | | | NA | | | | | | |
| Sulfide | I/M | | | | | | | | | | | | NA | | | | | | |
| Thallium (based on thallium sulfate) | I/M | | | | | | | | | | | | NA | | | | | | |
| Vanadium | I/M | | | | | | | | | | | | NA | | | | | | |
| Zinc | I/M | | | | | | | | | | | | NC | | | | | | |
| **PESTICIDES/PCBs** | | | | | | | | | | | | | | | | | | | |
| 4,4'-DDD | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.2 | 1 | 1.05 | NA | MADEP, 1994 |
| 4,4'-DDE | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.2 | 1 | 1.05 | NA | MADEP, 1994 |
| 4,4'-DDT | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.2 | 1 | 1.05 | NA | MADEP, 1994 |
| Aldrin | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.25 | 1 | 1.05 | | MADEP, 1994 |
| alpha-BHC | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 0.96 | 0.18 | 0.97 | 1.05 | 0.97 | per MADEP, 1995 |
| Aroclor 1016 | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 0.85 | 0.07 | 1 | 1.05 | NA | MADEP, 1994 |
| beta-BHC | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 0.96 | 0.18 | 0.97 | 1.05 | .0.97 | per MADEP, 1995 |
| Chlordane (alpha & gamma isomers) | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.05 | 1 | 1.05 | NA | MADEP, 1994 |
| delta-BHC | P | | | | | | | | | | | | NC | | | | | | |
| Dieldrin | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.25 | 1 | 1.05 | NA | MADEP, 1994 |
| Endosulfan I | P | | | | | | | | | | | | NA | | | | | | |
| Endosulfan II | P | | | | | | | | | | | | NA | | | | | | |
| Endosulfan Sulfate | P | | | | | | | | | | | | NA | | | | | | |
| Endrin | P | | | | | | | | | | | | NC | | | | | | |
| Endrin aldehyde | P | | | | | | | | | | | | NA | | | | | | |
| Endrin ketone | P | | | | | | | | | | | | NA | | | | | | |
| Heptachlor | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.2 | 1 | 1.05 | NA | MADEP, 1994 |
| Heptachlor Epoxide | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.2 | 1 | 1.05 | NA | MADEP, 1994 |
| Lindane (gamma-BHC) | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.2 | 1 | 1.05 | NA | MADEP, 1994 |
| Methoxychlor | P | | | | | | | | | | | | NC | | | | | | |
| Polychlorinated Biphenyl (PCBs) | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 0.85 | 0.067 | 1 | 1.05 | NA | MADEP, 1994 |
| Toxaphene | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 0.96 | 0.18 | 0.97 | 1.05 | 0.97 | per MADEP, 1995 |
| **VOLATILES** | | | | | | | | | | | | | | | | | | | |
| 1,1,1-Trichloroethane | V | | | | | | | | | | | | NC | | | | | | |
| 1,1,2,2-Tetrachloroethane | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | G | 1 | 1.4 | 1 | 1.00 | NA | MADEP, 1994 |
| 1,1,2-Trichloroethane | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | G | 1 | 1 | 1 | 1.00 | NA | MADEP, 1994 |

**TABLE A4-5**
**RELATIVE ABSORPTION FACTORS**
**FOR CARCINOGENIC EFFECTS**

**Olin Corporation**
**Wilmington, MA Facility**

| | | SITE OF EXPOSURE [a] | | | | | STUDY EXPOSURE ROUTE [a] | | | | | | RAF - CANCER | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ANALYTE | CHEMICAL TYPE | Soil Ingestion | Soil Dermal Contact | Water Ingestion | Water Dermal Contact | Produce Ingestion | Gavage | Drinking Water | Dietary (food) | Injection | Inhalation | Dermal Contact | Dose-response Study Type [b] | Soil Cancer Oral | Soil Cancer Dermal | Water Cancer Oral | Water Cancer Dermal | Produce Ingestion Oral | RAF Source [c] |
| 1,1-Dichloroethane | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | G | 0.99 | 0.11 | 0.99 | 1.00 | 0.99 | per MADEP, 1995 |
| 1,1-Dichloroethene | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | W | 1.02 | 0.102 | 1.02 | 1.00 | NA | MADEP, 1994 |
| 1,2-Dichloroethane | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | G | 1 | 0.1 | 1 | 1.00 | NA | MADEP, 1994 |
| 1,2-Dichloroethene (total) | V | | | | | | | | | | | | NA | | | | | | |
| cis-1,2-Dichloroethene | V | | | | | | | | | | | | NC | | | | | | |
| trans-1,2-Dichloroethene | V | | | | | | | | | | | | NA | | | | | | |
| 1,2-Dichloropropane | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | G | 1 | 0.2 | 1 | 1.00 | NA | MADEP, 1994 |
| 1,3,5-Trimethylbenzene | V | | | | | | | | | | | | NA | | | | | | |
| 2,4,4-Trimethyl-1-pentene | V | | | | | | | | | | | | NA | | | | | | |
| 2,4,4-Trimethyl-2-pentene | V | | | | | | | | | | | | NA | | | | | | |
| 2-Butanone (Methyl Ethyl Ketone) | V | | | | | | | | | | | | NC | | | | | | |
| 2-Hexanone | V | | | | | | | | | | | | NA | | | | | | |
| 4-Methyl-2-pentanone (MIBK) | V | | | | | | | | | | | | NA | | | | | | |
| Acetone | V | | | | | | | | | | | | NC | | | | | | |
| Benzene | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | I | 1 | 0.08 | 1 | 1.10 | NA | MADEP, 1994 |
| Bromodichloromethane | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | G | 1 | 0.1 | 1 | 1.00 | NA | MADEP, 1994 |
| Bromoform | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | G | 1 | 0.1 | 1 | 1.00 | NA | MADEP, 1994 |
| Carbon Disulfide | V | | | | | | | | | | | | NA | | | | | | |
| Carbon Tetrachloride | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | G | 1 | 0.1 | 1 | 1.00 | NA | MADEP, 1994 |
| Chlorobenzene | V | | | | | | | | | | | | NC | | | | | | |
| Chloroform | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | W | 1 | 0.1 | 1 | 1.00 | NA | MADEP, 1994 |
| Chloromethane | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | I | 1.09 | 0.12 | 1.09 | 1.10 | 1.09 | per MADEP, 1995 |
| Dibromochloromethane | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | G | 1 | 0.1 | 1 | 1.00 | NA | MADEP, 1994 |
| Ethyl chloride (Chlorethane) | V | | | | | | | | | | | | NA | | | | | | |
| Ethylbenzene | V | | | | | | | | | | | | NC | | | | | | |
| Hexachlorobutadiene | B, V | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.2 | 1 | 1.05 | NA | MADEP, 1994 |
| Methylene Chloride (Dichloromethane) | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | W | 1 | 0.1 | 1 | 1.00 | NA | MADEP, 1994 |
| Styrene | V | | | | | | | | | | | | NA | | | | | | |
| Tetrachloroethene | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | G | 1 | 0.1 | 1 | 1.00 | NA | MADEP, 1994 |
| Toluene | V | | | | | | | | | | | | NC | | | | | | |
| Trichloroethene | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | G | 1 | 0.1 | 1 | 1.00 | NA | MADEP, 1994 |
| Vinyl Acetate | V | | | | | | | | | | | | NA | | | | | | |
| Vinyl Chloride [e] | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | 0.98 | 1 | 0.91 | 0.11 | D | 1.53 | 0.16 | 1.53 | 1.02 | NA | MADEP, 1994 |
| Xylenes (total) | V | | | | | | | | | | | | NC | | | | | | |

NOTES:
NC = Not carcinogenic
NA = Not available
ND = Analyte is a potential carcinogen, but dose-response data are not available.

SOURCES:
MADEP, 1994: Background Documentation for the Development of the MCP Numerical Standards (April, 1994).
RAFs are those provided in Table 2-1 of this document, and were not calculated by ABB-ES.
MADEP, 1995: Guidance for Disposal Site Risk Characterization, Appendix B, Section K "Absorption Efficiency".

**TABLE A4-5**
**RELATIVE ABSORPTION FACTORS**
**FOR CARCINOGENIC EFFECTS**

**Olin Corporation**
**Wilmington, MA Facility**

| ANALYTE | CHEMICAL TYPE | SITE OF EXPOSURE [a] Soil Ingestion | Soil Dermal Contact | Water Ingestion | Water Dermal Contact | Produce Ingestion | STUDY EXPOSURE ROUTE [a] Gavage | Drinking Water | Dietary (food) | Injection | Inhalation | Dermal Contact | RAF - CANCER Dose-response Study Type [b] | Soil Cancer Oral | Soil Cancer Dermal | Water Cancer Oral | Water Cancer Dermal | Produce Ingestion Oral | RAF Source [c] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

W = Drinking water
G = Gavage
D = Dietary/food
I = Inhalation
IV = Injection
DC= Dermal contact
RAF = Relative absorption factor
VOC = Volatile organic compound
SVOC = Semivolatile organic compound

[a] Source is MADEP, 1995, unless otherwise noted.
[b] Study type for which the dose-response value is based. This information is provided in the dose-response tables.
[c] For RAF sources identified as "per MADEP, 1995", the RAF was calculated by dividing absorption efficiency for the site of exposure by the absorption efficiency for the study exposure route.
The default absorption efficiencies provided below were used if data were not located in the literature. The values for SVOCs were used as surrogates for pesticides.
All water dermal RAFs were calculated per MADEP, 1995.
[d] Quantitative absorption data were not available for the drinking water exposure route. A value of 1 (representing 100% absorption) was used to be conservative.
[e] No MADEP default value for the dietary route; a value of 98% dietary absorption was obtained from Risk Assessment Residential Shortform (MADEP, 1992).

| Default Absorption Efficiencies (from MADEP, 1995) | | | |
|---|---|---|---|
| Route/Medium of Exposure | VOCs | SVOCs | Inorganics |
| *SITE* | | | |
| Soil Ingestion | 0.99 | 0.91 | 0.39 |
| Soil Dermal Contact | 0.11 | 0.17 | 0.03 |
| Water Ingestion | 0.99 | 0.92 | 0.4 |
| Water Dermal Contact [a] | 1 | 1 | 1 |
| Produce Ingestion | 0.99 | 0.92 | 0.39 |
| | | | |
| *STUDY* | | | |
| Gavage (Oil) | 1 | 0.91 | NA |
| Drinking Water | 1 | NA | 0.55 |
| Food | NA | 0.95 | 0.21 |
| Injection | 1 | 1 | 1 |
| Inhalation | 0.91 | NA | NA |
| Dermal Contact | 0.11 | 0.14 | 0.017 |

[a] Per MADEP (1995), the RAF for dermal contact with water is calculated for an abosorbed dose. Therefore, the absorption efficiency for the site of exposure is assumed to be 100%.

**TABLE A4-6**
**RELATIVE ABSORPTION FACTORS**
**FOR NONCARCINOGENIC EFFECTS**

**Olin Corporation**
**Wilmington, MA Facility**

| | | SITE OF EXPOSURE [a] | | | | | STUDY EXPOSURE ROUTE [a] | | | | | | RAF - NON-CANCER | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ANALYTE | CHEMICAL TYPE | Soil Ingestion | Soil Dermal Contact | Water Ingestion | Water Dermal Contact | Produce Ingestion | Gavage | Drinking Water | Dietary (food) | Injection | Inhalation | Dermal Contact | Dose-response Study Type [b] | Soil Subchronic Oral | Soil Subchronic Dermal | Soil Chronic Oral | Soil Chronic Dermal | Water Chronic Oral | Water Chronic Dermal | Produce Ingestion Oral | RAF Source [c] |
| ACID EXTRACTABLE COMPOUNDS | | | | | | | | | | | | | | | | | | | | | |
| 2,4,6-Trichlorophenol [d] | A | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | W | 1 | 0.4 | 1 | 0.4 | 1 | 1.10 | NA | MADEP, 1994 |
| 2,4-Dichlorophenol [t] | A | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | W | 1 | 0.4 | 1 | 0.4 | 1 | 1.10 | NA | MADEP, 1994 |
| 2,4-Dimethylphenol | A | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | G | 1 | 0.26 | 1 | 0.26 | 1 | 1.10 | NA | MADEP, 1994 |
| 2,4-Dinitrophenol | A | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.26 | 1 | 0.26 | 1 | 1.05 | NA | MADEP, 1994 |
| 2-Chlorophenol [t] | A | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | W | 1 | 0.26 | 1 | 0.26 | 1 | 1.10 | NA | MADEP, 1994 |
| 2-Methylphenol (o-Cresol) | A | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | G | 1.00 | 0.19 | 1.00 | 0.19 | 1.01 | 1.10 | 1.01 | per MADEP, 1995 |
| 2-Nitrophenol [g] | A | | | | | | | | | | | | NA | 1 | 0.26 | 1 | 0.26 | 1 | 1.10 | NA | MADEP, 1994 |
| 4,6-Dinitro-2-methylphenol [h] | A | | | | | | | | | | | | NA | 1 | 0.26 | 1 | 0.26 | 1 | 1.05 | NA | MADEP, 1994 |
| 4-Chloro-3-methylphenol | A | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | G | 1.00 | 0.19 | 1.00 | 0.19 | 1.01 | 1.10 | 1.01 | per MADEP, 1995 |
| 4-Methylphenol (p-Cresol) | A | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | G | 1.00 | 0.19 | 1.00 | 0.19 | 1.01 | 1.10 | 1.01 | per MADEP, 1995 |
| 4-Nitrophenol [g] | A | | | | | | | | | | | | NA | 1 | 0.26 | 1 | 0.26 | 1 | 1.10 | NA | MADEP, 1994 |
| Benzoic Acid | A | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 0.96 | 0.18 | 0.96 | 0.18 | 0.97 | 1.05 | 0.97 | per MADEP, 1995 |
| Phenol | A | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | G | 1 | 0.26 | 1 | 0.26 | 1 | 1.10 | NA | MADEP, 1994 |
| BASE NEUTRAL COMPOUNDS | | | | | | | | | | | | | | | | | | | | | |
| 1,2,3-Trichlorobenzene [o] | B | | | | | | | | | | | | NA | 1 | 0.08 | 1 | 0.08 | 1 | 1.05 | NA | MADEP, 1994 |
| 1,2,4-Trichlorobenzene [s] | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | W | 1 | 0.08 | 1 | 0.08 | 1 | 1.05 | NA | MADEP, 1994 |
| 1,2-Dichlorobenzene | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.1 | 1 | 0.1 | 1 | 1.05 | NA | MADEP, 1994 |
| 1,3-Dichlorobenzene | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 0.96 | 0.18 | 0.96 | 0.18 | 0.97 | 1.05 | 0.97 | per MADEP, 1995 |
| 1,4-Dichlorobenzene | B, V | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 0.96 | 0.18 | 0.96 | 0.18 | 0.97 | 1.05 | 0.97 | per MADEP, 1995 |
| 2,6-Dinitrotoluene | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 0.96 | 0.18 | 0.96 | 0.18 | 0.97 | 1.05 | 0.97 | per MADEP, 1995 |
| 2-Methylnaphthalene [i] | B | | | | | | | | | | | | NA | 1 | 0.2 | 1 | 0.2 | 1 | 1.10 | NA | MADEP, 1994 |
| 4-Bromophenyl-phenylether | B | | | | | | | | | | | | NA | NA | NA | NA | NA | NA | NA | NA | |
| 4-Chloroaniline | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.1 | 1 | 0.1 | 1 | 1.05 | NA | MADEP, 1994 |
| 4-Chlorophenyl-phenylether | B | | | | | | | | | | | | NA | NA | NA | NA | NA | NA | NA | NA | |
| 4-Nitroaniline [j] | B | | | | | | | | | | | | NA | 1 | 0.1 | 1 | 0.1 | 1 | 1.05 | NA | MADEP, 1994 |
| Acenaphthene | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | G | 1 | 0.2 | 1 | 0.2 | 1 | 1.10 | NA | MADEP, 1994 |
| Acenaphthylene | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | G | 0.91 | 0.18 | 0.91 | 0.18 | 0.91 | 1.10 | NA | MADEP, 1994 |
| Anthracene | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | G | 1 | 0.29 | 1 | 0.29 | 1 | 1.10 | NA | MADEP, 1994 |
| Benzo(a)anthracene | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | G | 0.91 | 0.18 | 0.91 | 0.18 | 0.91 | 1.10 | NA | MADEP, 1994 |
| Benzo(a)pyrene | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | G | 0.91 | 0.18 | 0.91 | 0.18 | 0.91 | 1.10 | NA | MADEP, 1994 |
| Benzo(b)fluoranthene | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | G | 0.91 | 0.18 | 0.91 | 0.18 | 0.91 | 1.10 | NA | MADEP, 1994 |
| Benzo(g,h,i)perylene | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | G | 0.91 | 0.18 | 0.91 | 0.18 | 0.91 | 1.10 | NA | MADEP, 1994 |
| Benzo(k)fluoranthene | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | G | 0.91 | 0.18 | 0.91 | 0.18 | 0.91 | 1.10 | NA | MADEP, 1994 |
| Benzyl Alcohol | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | G | 1.00 | 0.19 | 1.00 | 0.19 | 1.01 | 1.10 | 1.01 | per MADEP, 1995 |
| Bis(2-ethylhexyl)phthalate (BEHP) | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.02 | 1 | 0.02 | 1 | 1.05 | NA | MADEP, 1994 |
| Bis(Chloromethyl)ether | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 0.96 | 0.18 | 0.96 | 0.18 | 0.97 | 1.05 | 0.97 | per MADEP, 1995 |
| Butylbenzylphthalate | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 0.96 | 0.18 | 0.96 | 0.18 | 0.97 | 1.05 | 0.97 | per MADEP, 1995 |
| Chrysene | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | G | 0.91 | 0.18 | 0.91 | 0.18 | 0.91 | 1.10 | NA | MADEP, 1994 |
| Di-n-butylphthalate | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 0.96 | 0.18 | 0.96 | 0.18 | 0.97 | 1.05 | 0.97 | per MADEP, 1995 |
| Di-n-octylphthalate | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 0.96 | 0.18 | 0.96 | 0.18 | 0.97 | 1.05 | 0.97 | per MADEP, 1995 |
| Dibenzo(a,h)anthracene | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | G | 0.91 | 0.08 | 0.91 | 0.08 | 0.91 | 1.10 | NA | MADEP, 1994 |
| Dibenzofuran | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | G | 1 | 0.19 | 1 | 0.19 | 1.01 | 1.10 | 1.01 | per MADEP, 1995 |
| Diethylphthalate | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.02 | 1 | 0.02 | 1 | 1.05 | NA | MADEP, 1994 |
| Dimethylphthalate | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.07 | 1 | 0.07 | 1 | 1.05 | NA | MADEP, 1994 |
| Fluoranthene | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | G | 1 | 0.2 | 1 | 0.2 | 1 | 1.10 | NA | MADEP, 1994 |
| Fluorene | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | G | 1 | 0.2 | 1 | 0.2 | 1 | 1.10 | NA | MADEP, 1994 |

**TABLE A4-6**
**RELATIVE ABSORPTION FACTORS**
**FOR NONCARCINOGENIC EFFECTS**

**Olin Corporation**
**Wilmington, MA Facility**

| ANALYTE | CHEMICAL TYPE | SITE OF EXPOSURE [a] Soil Ingestion | Soil Dermal Contact | Water Ingestion | Water Dermal Contact | Produce Ingestion | STUDY EXPOSURE ROUTE [a] Gavage | Drinking Water | Dietary (food) | Injection | Inhalation | Dermal Contact | RAF - NON-CANCER Dose-response Study Type [b] | Soil Subchronic Oral | Soil Subchronic Dermal | Soil Chronic Oral | Soil Chronic Dermal | Water Chronic Oral | Water Chronic Dermal | Produce Ingestion Oral | RAF Source [c] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hexachlorobenzene | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.13 | 1 | 0.13 | 1 | 1.05 | NA | MADEP, 1994 |
| Indeno(1,2,3-cd)pyrene | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | G | 0.91 | 0.18 | 0.91 | 0.18 | 0.91 | 1.10 | NA | MADEP, 1994 |
| Isophorone | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | G | 1.00 | 0.19 | 1.00 | 0.19 | 1.01 | 1.10 | 1.01 | per MADEP, 1995 |
| n-Nitrosodi-n-propylamine [e] | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | 1 | 0.95 | 1 | NA | 0.14 | W | 0.91 | 0.17 | 0.91 | 0.17 | 0.92 | 1.00 | 0.92 | per MADEP, 1995 |
| n-Nitrosodiphenylamine | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 0.96 | 0.18 | 0.96 | 0.18 | 0.97 | 1.05 | 0.97 | per MADEP, 1995 |
| Naphthalene | B, V | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | G | 1 | 0.1 | 1 | 0.1 | 1 | 1.10 | NA | MADEP, 1994 |
| Nitrobenzene [f] | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | 0.8 | 0.14 | I | 1.14 | 0.21 | 1.14 | 0.21 | 1.15 | 1.25 | 1.15 | per MADEP, 1995 |
| Phenanthrene | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | G | 0.91 | 0.18 | 0.91 | 0.18 | 0.91 | 1.10 | NA | MADEP, 1994 |
| Pyrene | B | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | G | 1 | 0.2 | 1 | 0.2 | 1 | 1.10 | NA | MADEP, 1994 |
| INORGANICS/METALS | | | | | | | | | | | | | | | | | | | | | |
| Aluminum | I/M | | | | | | | | | | | | NA | NA | NA | NA | NA | NA | NA | NA | |
| Antimony | I/M | 0.39 | 0.03 | 0.4 | 1 | 0.39 | NA | 0.55 | 0.21 | 1 | NA | 0.017 | W | 1 | 0.1 | 1 | 0.1 | 1 | 1.82 | NA | MADEP, 1994 |
| Arsenic | I/M | 0.39 | 0.03 | 0.4 | 1 | 0.39 | NA | 0.55 | 0.21 | 1 | NA | 0.017 | W | 1 | 0.03 | 1 | 0.03 | 1 | 1.82 | NA | MADEP, 1994 |
| Barium | I/M | 0.39 | 0.03 | 0.4 | 1 | 0.39 | NA | 0.55 | 0.21 | 1 | NA | 0.017 | W | 0.71 | 0.05 | 0.71 | 0.05 | 0.73 | 1.82 | 0.71 | per MADEP, 1995 |
| Beryllium | I/M | 0.39 | 0.03 | 0.4 | 1 | 0.39 | NA | 0.55 | 0.21 | 1 | NA | 0.017 | W | 1 | 0.03 | 1 | 0.03 | 1 | 1.82 | NA | MADEP, 1994 |
| Cadmium (food) | I/M | 0.39 | 0.03 | 0.4 | 1 | 0.39 | NA | 0.55 | 0.21 | 1 | NA | 0.017 | D | 1.86 | 0.14 | 1.86 | 0.14 | 1.90 | 4.76 | 1.86 | per MADEP, 1995 |
| Cadmium (water) | I/M | 0.39 | 0.03 | 0.4 | 1 | 0.39 | NA | 0.55 | 0.21 | 1 | NA | 0.017 | W | 1 | 0.14 | 1 | 0.14 | 1 | 1.82 | NA | MADEP, 1994 |
| Calcium | I/M | | | | | | | | | | | | NA | | NA | NA | NA | NA | NA | NA | |
| Chloride | I/M | | | | | | | | | | | | NA | | | | | | | | |
| Chromium III | I/M | 0.39 | 0.03 | 0.4 | 1 | 0.39 | NA | 0.55 | 0.21 | 1 | NA | 0.017 | D | 1 | 0.04 | 1 | 0.04 | 1 | 4.76 | NA | MADEP, 1994 |
| Chromium VI | I/M | 0.39 | 0.03 | 0.4 | 1 | 0.39 | NA | 0.55 | 0.21 | 1 | NA | 0.017 | W | 1 | 0.09 | 1 | 0.09 | 1 | 1.82 | NA | MADEP, 1994 |
| Cobalt (adult) | I/M | 0.39 | 0.03 | 0.4 | 1 | 0.39 | NA | 0.55 | 0.21 | 1 | NA | 0.017 | D | 1.86 | 0.14 | 1.86 | 0.14 | 1.90 | 4.76 | 1.86 | per MADEP, 1995 |
| Cobalt (child) | I/M | 0.39 | 0.03 | 0.4 | 1 | 0.39 | NA | 0.55 | 0.21 | 1 | NA | 0.017 | D | 1.86 | 0.14 | 1.86 | 0.14 | 1.90 | 4.76 | 1.86 | per MADEP, 1995 |
| Copper | I/M | | | | | | | | | | | | NA | | NA | NA | NA | NA | NA | NA | |
| Cyanide | I/M | 0.39 | 0.03 | 0.4 | 1 | 0.39 | NA | 0.55 | 0.21 | 1 | NA | 0.017 | D | 1 | 0.3 | 1 | 0.3 | 1 | 4.76 | NA | MADEP, 1994 |
| Iron | I/M | | | | | | | | | | | | NA | | NA | NA | NA | NA | NA | NA | |
| Lead | I/M | | | | 1 | | | 0.5 | | | | | W | 0.5 | 0.006 | 0.5 | 0.006 | 0.5 | 2.00 | 0.5 | MADEP, 1992 |
| Magnesium | I/M | | | | | | | | | | | | NA | | NA | NA | NA | NA | NA | NA | |
| Manganese (drinking water) | I/M | 0.39 | 0.03 | 0.4 | 1 | 0.39 | NA | 0.55 | 0.21 | 1 | NA | 0.017 | D | 1.86 | 0.14 | 1.86 | 0.14 | 1.90 | 4.76 | 1.86 | per MADEP, 1995 |
| Manganese (food) | I/M | 0.39 | 0.03 | 0.4 | 1 | 0.39 | NA | 0.55 | 0.21 | 1 | NA | 0.017 | D | 1.86 | 0.14 | 1.86 | 0.14 | 1.90 | 4.76 | 1.86 | per MADEP, 1995 |
| Manganese (soil) | I/M | 0.39 | 0.03 | 0.4 | 1 | 0.39 | NA | 0.55 | 0.21 | 1 | NA | 0.017 | D | 1.86 | 0.14 | 1.86 | 0.14 | 1.90 | 4.76 | 1.86 | per MADEP, 1995 |
| Mercury (as Mercuric chloride) | I/M | 0.39 | 0.03 | 0.4 | 1 | 0.39 | NA | 0.55 | 0.21 | 1 | NA | 0.017 | D | 1 | 0.05 | 1 | 0.05 | 1 | 4.76 | NA | MADEP, 1994 |
| Nickel | I/M | 0.39 | 0.03 | 0.4 | 1 | 0.39 | NA | 0.55 | 0.21 | 1 | NA | 0.017 | D | 1 | 0.35 | 1 | 0.35 | 1 | 4.76 | NA | MADEP, 1994 |
| Nitrate | I/M | 0.39 | 0.03 | 0.4 | 1 | 0.39 | NA | 0.55 | 0.21 | 1 | NA | 0.017 | W | 0.71 | 0.05 | 0.71 | 0.05 | 0.73 | 1.82 | 0.71 | per MADEP, 1995 |
| Nitrite | I/M | 0.39 | 0.03 | 0.4 | 1 | 0.39 | NA | 0.55 | 0.21 | 1 | NA | 0.017 | W | 0.71 | 0.05 | 0.71 | 0.05 | 0.73 | 1.82 | 0.71 | per MADEP, 1995 |
| Nitrogen, Ammonia | I/M | 0.39 | 0.03 | 0.4 | 1 | 0.39 | NA | 0.55 | 0.21 | 1 | NA | 0.017 | W | 0.71 | 0.05 | 0.71 | 0.05 | 0.73 | 1.82 | 0.71 | per MADEP, 1995 |
| Potassium | I/M | | | | | | | | | | | | NA | | NA | NA | NA | NA | NA | NA | |
| Selenium | I/M | 0.39 | 0.03 | 0.4 | 1 | 0.39 | NA | 0.55 | 0.21 | 1 | NA | 0.017 | D | 1 | 0.002 | 1 | 0.002 | 1 | 4.76 | NA | MADEP, 1994 |
| Silver | I/M | 0.39 | 0.03 | 0.4 | 1 | 0.39 | NA | 0.55 | 0.21 | 1 | NA | 0.017 | IV | 1 | 0.25 | 1 | 0.25 | 1 | 1.00 | NA | MADEP, 1994 |
| Sodium | I/M | | | | | | | | | | | | NA | | NA | NA | NA | NA | NA | NA | |
| Strontium | I/M | 0.39 | 0.03 | 0.4 | 1 | 0.39 | NA | 0.55 | 0.21 | 1 | NA | 0.017 | D | 1.86 | 0.14 | 1.86 | 0.14 | 1.90 | 4.76 | 1.86 | per MADEP, 1995 |
| Sulfates as SO4 | I/M | 0.39 | 0.03 | 0.4 | 1 | 0.39 | NA | 0.55 | 0.21 | 1 | NA | 0.017 | W | 0.71 | 0.05 | 0.71 | 0.05 | 0.73 | 1.82 | 0.71 | per MADEP, 1995 |
| Sulfide | I/M | | | | | | | | | | | | NA | | | | | | | | |
| Thallium [p] | I/M | 0.39 | 0.03 | 0.4 | 1 | 0.39 | 1 | 0.55 | 0.21 | 1 | NA | 0.017 | G | 1 | 0.01 | 1 | 0.01 | 1 | 1.00 | NA | MADEP, 1994 |
| Vanadium | I/M | 0.39 | 0.03 | 0.4 | 1 | 0.39 | NA | 0.55 | 0.21 | 1 | NA | 0.017 | W | 0.71 | 0.05 | 0.71 | 0.05 | 0.73 | 1.82 | 0.71 | per MADEP, 1995 |
| Zinc | I/M | 0.39 | 0.03 | 0.4 | 1 | 0.39 | NA | 0.55 | 0.21 | 1 | NA | 0.017 | D | 1 | 0.02 | 1 | 0.02 | 1 | 4.76 | NA | MADEP, 1994 |

## TABLE A4-6
## RELATIVE ABSORPTION FACTORS
## FOR NONCARCINOGENIC EFFECTS

Olin Corporation
Wilmington, MA Facility

| | | SITE OF EXPOSURE [a] | | | | | STUDY EXPOSURE ROUTE [a] | | | | | | RAF - NON-CANCER | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ANALYTE | CHEMICAL TYPE | Soil Ingestion | Soil Dermal Contact | Water Ingestion | Water Dermal Contact | Produce Ingestion | Gavage | Drinking Water | Dietary (food) | Injection | Inhalation | Dermal Contact | Dose-response Study Type [b] | Soil Subchronic Oral | Soil Subchronic Dermal | Soil Chronic Oral | Soil Chronic Dermal | Water Chronic Oral | Water Chronic Dermal | Produce Ingestion Oral | RAF Source [c] |
| PESTICIDES/PCBs | | | | | | | | | | | | | | | | | | | | | |
| 4,4'-DDD [k] | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 0.96 | 0.18 | 0.96 | 0.18 | 0.97 | 1.05 | 0.97 | per MADEP, 1995 |
| 4,4'-DDE [k] | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 0.96 | 0.18 | 0.96 | 0.18 | 0.97 | 1.05 | 0.97 | per MADEP, 1995 |
| 4,4'-DDT | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 0.96 | 0.18 | 0.96 | 0.18 | 0.97 | 1.05 | 0.97 | per MADEP, 1995 |
| Aldrin | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.25 | 1 | 0.25 | 1 | 1.05 | NA | MADEP, 1994 |
| alpha-BHC | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 0.96 | 0.18 | 0.96 | 0.18 | 0.97 | 1.05 | 0.97 | per MADEP, 1995 |
| Aroclor 1016 | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 0.96 | 0.18 | 0.96 | 0.18 | 0.97 | 1.05 | 0.97 | per MADEP, 1995 |
| beta-BHC | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 0.96 | 0.18 | 0.96 | 0.18 | 0.97 | 1.05 | 0.97 | per MADEP, 1995 |
| Chlordane (alpha & gamma isomers) | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.05 | 1 | 0.05 | 1 | 1.05 | NA | MADEP, 1994 |
| delta-BHC | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 0.96 | 0.18 | 0.96 | 0.18 | 0.97 | 1.05 | 0.97 | per MADEP, 1995 |
| Dieldrin | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.25 | 1 | 0.25 | 1 | 1.05 | NA | MADEP, 1994 |
| Endosulfan I | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 0.96 | 0.18 | 0.96 | 0.18 | 0.97 | 1.05 | 0.97 | per MADEP, 1995 |
| Endosulfan II | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 0.96 | 0.18 | 0.96 | 0.18 | 0.97 | 1.05 | 0.97 | per MADEP, 1995 |
| Endosulfan Sulfate | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 0.96 | 0.18 | 0.96 | 0.18 | 0.97 | 1.05 | 0.97 | per MADEP, 1995 |
| Endrin | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.25 | 1 | 0.25 | 1 | 1.05 | NA | MADEP, 1994 |
| Endrin aldehyde | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 0.96 | 0.18 | 0.96 | 0.18 | 0.97 | 1.05 | 0.97 | per MADEP, 1995 |
| Endrin ketone | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 0.96 | 0.18 | 0.96 | 0.18 | 0.97 | 1.05 | 0.97 | per MADEP, 1995 |
| Heptachlor | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.2 | 1 | 0.2 | 1 | 1.05 | NA | MADEP, 1994 |
| Heptachlor Epoxide | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.2 | 1 | 0.2 | 1 | 1.05 | NA | MADEP, 1994 |
| Lindane (gamma-BHC) | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.2 | 1 | 0.2 | 1 | 1.05 | NA | MADEP, 1994 |
| Methoxychlor | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | G | 1 | 0.2 | 1 | 0.2 | 1 | 1.10 | NA | MADEP, 1994 |
| Polychlorinated Biphenyl (PCBs) | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 0.85 | 0.067 | 0.85 | 0.067 | 1 | 1.05 | NA | MADEP, 1994 |
| Toxaphene | P | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 0.96 | 0.18 | 0.96 | 0.18 | 0.97 | 1.05 | 0.97 | per MADEP, 1995 |
| VOLATILES | | | | | | | | | | | | | | | | | | | | | |
| 1,1,1-Trichloroethane [r] | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | 1 | 1 | 0.91 | 0.11 | D | 1 | 0.1 | 1 | 0.1 | 1 | 1.00 | NA | MADEP, 1994 |
| 1,1,2,2-Tetrachloroethane | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | G | 0.99 | 0.11 | 0.99 | 0.11 | 0.99 | 1.00 | NA | per MADEP, 1995 |
| 1,1,2-Trichloroethane | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | W | 1 | 1 | 1 | 1 | 1 | 1.00 | NA | MADEP, 1994 |
| 1,1-Dichloroethane | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | I | 1.3 | 0.13 | 1.3 | 0.13 | 1.3 | 1.10 | NA | MADEP, 1994 |
| 1,1-Dichloroethene | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | W | 1 | 0.1 | 1 | 0.1 | 1 | 1.00 | NA | MADEP, 1994 |
| 1,2-Dichloroethane | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | I | 1 | 0.1 | 1 | 0.1 | 1 | 1.10 | NA | MADEP, 1994 |
| 1,2-Dichloroethene (total) | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | W | 1 | 0.1 | 1 | 0.1 | 1 | 1.00 | NA | MADEP, 1994 |
| cis-1,2-Dichloroethene | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | G | 0.99 | 0.11 | 0.99 | 0.11 | 0.99 | 1.00 | 0.99 | per MADEP, 1995 |
| trans-1,2-Dichloroethene | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | W | 1 | 0.1 | 1 | 0.1 | 1 | 1.00 | NA | MADEP, 1994 |
| 1,2-Dichloropropane | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | G | 0.99 | 0.11 | 0.99 | 0.11 | 0.99 | 1.00 | 0.99 | per MADEP, 1995 |
| 1,3,5-Trimethylbenzene [l] | V | | | | | | | | | | | | G | 1 | 0.12 | 1 | 0.12 | 1 | 1.00 | NA | MADEP, 1994 |
| 2,4,4-Trimethyl-1-pentene | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | G | 0.99 | 0.11 | 0.99 | 0.11 | 0.99 | 1.00 | 0.99 | per MADEP, 1995 |
| 2,4,4-Trimethyl-2-pentene | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | G | 0.99 | 0.11 | 0.99 | 0.11 | 0.99 | 1.00 | 0.99 | per MADEP, 1995 |
| 2-Butanone (Methyl Ethyl Ketone) | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | W | 1 | 0.1 | 1 | 0.1 | 1 | 1.00 | NA | MADEP, 1994 |
| 2-Hexanone [m] | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | W | 1 | 0.1 | 1 | 0.1 | 1 | 1.00 | NA | MADEP, 1994 |
| 4-Methyl-2-pentanone (MIBK) | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | G | 1 | 0.1 | 1 | 0.1 | 1 | 1.00 | NA | MADEP, 1994 |
| Acetone | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | G | 1 | 0.1 | 1 | 0.1 | 1 | 1.00 | NA | MADEP, 1994 |
| Benzene | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | I | 1 | 0.08 | 1 | 0.08 | 1 | 1.10 | NA | MADEP, 1994 |
| Bromodichloromethane | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | G | 1 | 0.1 | 1 | 0.1 | 1 | 1.00 | NA | MADEP, 1994 |
| Bromoform | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | G | 1 | 0.11 | 1 | 0.11 | 1 | 1.00 | NA | MADEP, 1994 |
| Carbon Disulfide | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | I | 1.09 | 0.12 | 1.09 | 0.12 | 1.09 | 1.10 | 1.09 | per MADEP, 1995 |
| Carbon Tetrachloride | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | G | 1 | 0.1 | 1 | 0.1 | 1 | 1.00 | NA | MADEP, 1994 |
| Chlorobenzene | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | G | 1 | 0.1 | 1 | 0.1 | 1 | 1.00 | NA | MADEP, 1994 |
| Chloroform | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | G | 1 | 0.1 | 1 | 0.1 | 1 | 1.00 | NA | MADEP, 1994 |
| Chloromethane [n] | V | | | | | | | | | | | | NA | 1 | 0.1 | 1 | 0.1 | 1 | 1.00 | NA | MADEP, 1994 |
| Dibromochloromethane | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | G | 1 | 0.1 | 1 | 0.1 | 1 | 1.00 | NA | MADEP, 1994 |

**TABLE A4-8**
**RELATIVE ABSORPTION FACTORS**
**FOR NONCARCINOGENIC EFFECTS**

**Olin Corporation**
**Wilmington, MA Facility**

| ANALYTE | CHEMICAL TYPE | SITE OF EXPOSURE [a] Soil Ingestion | Soil Dermal Contact | Water Ingestion | Water Dermal Contact | Produce Ingestion | STUDY EXPOSURE ROUTE [a] Gavage | Drinking Water | Dietary (food) | Injection | Inhalation | Dermal Contact | RAF - NON-CANCER Dose-response Study Type [b] | Soil Subchronic Oral | Soil Subchronic Dermal | Soil Chronic Oral | Soil Chronic Dermal | Water Chronic Oral | Water Chronic Dermal | Produce Ingestion Oral | RAF Source [c] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ethyl chloride (Chlorethane) [n] | V | | | | | | | | | | | | NA | 1 | 0.1 | 1 | 0.1 | 1 | 1.00 | NA | MADEP, 1994 |
| Ethylbenzene | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | G | 1 | 0.2 | 1 | 0.2 | 1 | 1.00 | NA | MADEP, 1994 |
| Hexachlorobutadiene | B, V | 0.91 | 0.17 | 0.92 | 1 | 0.92 | 0.91 | NA | 0.95 | 1 | NA | 0.14 | D | 1 | 0.2 | 1 | 0.2 | 1 | 1.05 | NA | MADEP, 1994 |
| Methylene Chloride (Dichloromethane) | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | W | 1 | 0.1 | 1 | 0.1 | 1 | 1.00 | NA | MADEP, 1994 |
| Styrene | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | G | 1 | 0.2 | 1 | 0.2 | 1 | 1.00 | NA | MADEP, 1994 |
| Tetrachloroethene | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | G | 1 | 0.1 | 1 | 0.1 | 1 | 1.00 | NA | MADEP, 1994 |
| Toluene | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | G | 1 | 0.12 | 1 | 0.12 | 1 | 1.00 | NA | MADEP, 1994 |
| Trichloroethene | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | I | 1 | 0.1 | 1 | 0.1 | 1 | 1.10 | NA | MADEP, 1994 |
| Vinyl Acetate | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | W | 0.99 | 0.11 | 0.99 | 0.11 | 0.99 | 1.00 | 0.99 | per MADEP, 1995 |
| Vinyl Chloride [q] | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | 0.98 | 1 | 0.91 | 0.11 | D | 1 | 0.1 | 1 | 0.1 | 1 | 1.02 | NA | MADEP, 1994 |
| Xylenes (total) | V | 0.99 | 0.11 | 0.99 | 1 | 0.99 | 1 | 1 | NA | 1 | 0.91 | 0.11 | G | 1 | 0.12 | 1 | 0.12 | 1 | 1.00 | NA | MADEP, 1994 |
| | | | | | | | | | | | | | NA | | | | | | | | |

**NOTES:**

NA = Not available
W = Drinking water
G = Gavage
D = Dietary/food
I = Inhalation
IV = Injection
DC = Dermal contact
RAF = Relative absorption factor
VOC = Volatile organic compound
SVOC = Semivolatile organic compound

**SOURCES:**

MADEP, 1992: Risk Assessment Shortform Residential Scenario. WSC/ORS-142-92.

MADEP, 1994: Background Documentation for the Development of the MCP Numerical Standards (April, 1994).
RAFs are those provided in Table 2-1 of this document, and were not calculated by ABB-ES.

MADEP, 1995: Guidance for Disposal Site Risk Characterization, Appendix B, Section K "Absorption Efficiency".

[a] Source is MADEP, 1995, unless otherwise noted.

[b] Study type for which the dose-response value is based. This information is provided in the dose-response tables.

[c] For RAF sources identified as "per MADEP, 1995", the RAF was calculated by dividing absorption efficiency for the site of exposure by the absorption efficiency for the study exposure route. The default absorption efficiencies provided below were used if data were not located in the literature. The values for SVOCs were used as surrogates for pesticides. All water dermal RAFs were calculated per MADEP, 1995.

[d] RAFs for ,4-Dichlorophenol was used as a surrogate.

[e] Quantitative absorption data were not available for the drinking water exposure route. A value of 1 (representing 100% absorption) was used to be conservative.

[f] For the inhalation exposure route, an inhalation absorption efficiency of 80% (0.8) was used per ATSDR, 1990.

[g] RAFs for 2-chlorophenol used as surrogate.

[h] RAFs for 2,4-dinitrophenol used as surrogate.

[i] RAFs for pyrene used as surrogate.

[j] RAFs for 4-chloroanaline used as surrogate.

[k] RAFs for DDT used as surrogate.

[l] RAFs for xylenes used as surrogate.

[m] RAFs for 2-butanone used as surrogate.

[n] RAFs for chloroform used as surrogate.

[o] 1,2,4-trimethylbenzene used as surrogate.

[p] No MADEP default value for the gavage route; a value of 100% oral absorption was obtained from Risk Assessment Residential Shortform (MADEP, 1992).

[q] No MADEP default value for the dietary route; a value of 98% dietary absorption was obtained from Risk Assessment Residential Shortform (MADEP, 1992).

[r] No MADEP default value for the dietary route; a value of 100% dietary absorption was assumed.

[s] Water dermal RAF based on water dermal RAF for dichlorobenzene.

[t] Water dermal RAF based on water dermal RAF for 2-methylphenol.

**TABLE A4-6**
**RELATIVE ABSORPTION FACTORS**
**FOR NONCARCINOGENIC EFFECTS**

**Olin Corporation**
**Wilmington, MA Facility**

| ANALYTE | CHEMICAL TYPE | SITE OF EXPOSURE [a] Soil Ingestion | Soil Dermal Contact | Water Ingestion | Water Dermal Contact | Produce Ingestion | STUDY EXPOSURE ROUTE [a] Gavage | Drinking Water | Dietary (food) | Injection | Inhalation | Dermal Contact | RAF - NON-CANCER Dose-response Study Type [b] | Soil Subchronic Oral | Soil Subchronic Dermal | Soil Chronic Oral | Soil Chronic Dermal | Water Chronic Oral | Water Chronic Dermal | Produce Ingestion Oral | RAF Source [c] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| Default Absorption Efficiencies (from MADEP, 1995) | | | |
|---|---|---|---|
| *Route/Medium of Exposure* | *VOCs* | *SVOCs* | *Inorganics* |
| *SITE* | | | |
| Soil Ingestion | 0.99 | 0.91 | 0.39 |
| Soil Dermal Contact | 0.11 | 0.17 | 0.03 |
| Water Ingestion | 0.99 | 0.92 | 0.4 |
| Water Dermal Contact [a] | 1 | 1 | 1 |
| Produce Ingestion | 0.99 | 0.92 | 0.39 |
| | | | |
| *STUDY* | | | |
| Gavage (Oil) | 1 | 0.91 | NA |
| Drinking Water | 1 | NA | 0.55 |
| Food | NA | 0.95 | 0.21 |
| Injection | 1 | 1 | 1 |
| Inhalation | 0.91 | NA | NA |
| Dermal Contact | 0.11 | 0.14 | 0.017 |

[a] Per MADEP (1995), the RAF for dermal contact with water is calculated for an abosorbed dose. Therefore, the absorption efficiency for the site of exposure is assumed to be 100%.

# TABLE A4-7
# EXPERIMENTALLY MEASURED AND ESTIMATED PERMEABILITY COEFFICIENT VALUES (Kp) FOR CHEMICALS IN AQUEOUS MEDIA

**Olin Corporation**
**Wilmington, MA Facility**

| Analyte | Measured Kp (cm/hr) | Estimated Kp (cm/hr) | Source [1] |
|---|---|---|---|
| **VOLATILES** | | | |
| 1,1,1-Trichloroethane | | 1.70E-02 | MADEP 1995 |
| 1,2-Dichloroethene (total) [2] | | 1.00E-02 | MADEP 1995 |
| 2,4,4-Trimethyl-1-pentene [7] | | 2.32E-01 | Calculated [3] |
| 2,4,4-Trimethyl-2-pentene [7] | | 2.32E-01 | Calculated [3] |
| 2-Butanone (MEK) | 5.00E-03 | 1.10E-03 | MADEP 1995 |
| 2-Hexanone [8] | | 1.10E-03 | MADEP 1995 |
| 4-Methyl-2-Pentanone (MIBK) | | 3.41E-03 | Calculated [3] |
| Acetone | | 5.69E-04 | Calculated [3] |
| Bromodichloromethane | | 5.80E-03 | MADEP 1995 |
| Bromoform | | 2.60E-03 | MADEP 1995 |
| Carbon Disulfide | 5.00E-01 | 2.40E-02 | MADEP 1995 |
| Carbon Tetrachloride | | 2.20E-02 | MADEP 1995 |
| Chloroethane | | 8.00E-03 | MADEP 1995 |
| Chloroform | 1.30E-01 | 8.90E-03 | MADEP 1995 |
| Dibromochloromethane | | 3.90E-03 | MADEP 1995 |
| Ethylbenzene | 1.00E+00 | 7.40E-02 | MADEP 1995 |
| Methylene Chloride | | 4.50E-03 | MADEP 1995 |
| Toluene | 1.00E+00 | 4.50E-02 | MADEP 1995 |
| Trichloroethene | 2.30E-01 | 1.60E-02 | MADEP 1995 |
| Vinyl Chloride | | 7.30E-03 | MADEP 1995 |
| Xylenes, total [4] | | 8.00E-02 | MADEP 1995 |
| **SEMIVOLATILES** | | | |
| 1,2,4-Trichlorobenzene | | 1.00E-01 | MADEP 1995 |
| 1,3-Dichlorobenzene | | 8.70E-02 | MADEP 1995 |
| 1,4-Dichlorobenzene | | 6.20E-02 | MADEP 1995 |
| 2-methylphenol (o-cresol) | 1.60E-02 | 1.00E-02 | MADEP 1995 |
| 4-methylphenol (p-cresol) | 1.80E-02 | 1.00E-02 | MADEP 1995 |
| 4-Nitrophenol | 5.60E-03 | 6.10E-03 | MADEP 1995 |
| Benzo(a)anthracene | | 8.10E-01 | MADEP 1995 |
| Benzo(a)Pyrene | | 1.20E+00 | MADEP 1995 |
| Benzo(b)fluoranthene | | 1.20E+00 | MADEP 1995 |
| Benzo(k)fluoranthene | | 1.11E+00 | Calculated [3] |
| bis(2-ethylhexyl)phthalate | | 5.31E-03 | Calculated [3] |
| Chrysene | | 8.10E-01 | MADEP 1995 |
| Di-n-octylphthalate | | 2.86E+01 | Calculated [3] |
| Fluoranthene | | 3.60E-01 | MADEP 1995 |

# TABLE A4-7
# EXPERIMENTALLY MEASURED AND ESTIMATED PERMEABILITY COEFFICIENT VALUES (Kp) FOR CHEMICALS IN AQUEOUS MEDIA

**Olin Corporation**
**Wilmington, MA Facility**

| Analyte | Measured Kp (cm/hr) | Estimated Kp (cm/hr) | Source [1] |
|---|---|---|---|
| Indeno(1,2,3-cd)pyrene | | 1.90E+00 | MADEP 1995 |
| N-Nitrosodiphenylamine | | 1.88E-02 | Calculated [3] |
| Phenanthrene | | 2.30E-01 | MADEP 1995 |
| Phenol | 8.20E-03 | 5.50E-03 | MADEP 1995 |
| Pyrene | | 3.24E-01 | Calculated [3] |
| **PESTICIDES AND PCBs** | | | |
| Alpha-BHC | | 1.88E-02 | Calculated [3] |
| Delta-BHC | | 2.61E-02 | Calculated [3] |
| Endosulfan sulfate | | 9.45E-03 | Calculated [3] |
| Endrin aldehyde [5] | | 5.81E-02 | Calculated [3] |
| Gamma-BHC (Lindane) | | 1.40E-02 | MADEP 1995 |
| Heptachlor epoxide | | 6.57E-04 | Calculated [3] |
| **METALS/INORGANICS [6]** | | | |
| Aluminum | | 1.00E-03 | MADEP 1995 |
| Ammonia | | 1.00E-03 | MADEP 1995 |
| Arsenic | | 1.00E-03 | MADEP 1995 |
| Barium | | 1.00E-03 | MADEP 1995 |
| Calcium | | 1.00E-03 | MADEP 1995 |
| Chloride | | 1.00E-03 | MADEP 1995 |
| Chromium (total) | | 1.00E-03 | MADEP 1995 |
| Chromium, Hexavalent | | 1.00E-03 | MADEP 1995 |
| Cobalt | | 1.00E-03 | MADEP 1995 |
| Copper | | 1.00E-03 | MADEP 1995 |
| Iron | | 1.00E-03 | MADEP 1995 |
| Lead | | 1.00E-03 | MADEP 1995 |
| Magnesium | | 1.00E-03 | MADEP 1995 |
| Manganese | | 1.00E-03 | MADEP 1995 |
| Mercury | | 1.00E-03 | MADEP 1995 |
| Nickel | | 1.00E-03 | MADEP 1995 |
| Nitrate as N | | 1.00E-03 | MADEP 1995 |
| Nitrite as N | | 1.00E-03 | MADEP 1995 |
| Potassium | | 1.00E-03 | MADEP 1995 |
| Sodium | | 1.00E-03 | MADEP 1995 |
| Sulfate as $SO_4$ | | 1.00E-03 | MADEP 1995 |
| Sulfide | | 1.00E-03 | MADEP 1995 |
| Vanadium | | 1.00E-03 | MADEP 1995 |
| Zinc | | 1.00E-03 | MADEP 1995 |

## TABLE A4-7
## EXPERIMENTALLY MEASURED AND ESTIMATED PERMEABILITY COEFFICIENT VALUES (Kp) FOR CHEMICALS IN AQUEOUS MEDIA

**Olin Corporation**
**Wilmington, MA Facility**

| Analyte | Measured Kp (cm/hr) | Estimated Kp (cm/hr) | Source [1] |
|---|---|---|---|

NOTES:

[1] MADEP, 1995. Guidance for Disposal Site Risk Characterization. Interim Final Policy WSC/ORS-95-141.

[2] The estimated Kp value for trans-1,2-dichloroethene was used as a surrogate.

[3] Calculated using the following equation from "Dermal Exposure Assessment" (USEPA, 1992):
$\log Kp = -2.72 + 0.71 \log Kow - 0.0061 * MW$.
Kow or log Kow values were obtained from the Superfund Chemical Data Matrix (1993) and Basics of Pump-and-Treat Groundwater Remediation Technology (EPA, 1990).

[4] The estimated Kp value for m-xylene was used as a surrogate.

[5] The Kp value was calculated using the molecular weight and Kow for Endrin.

[6] Per MADEP, 1995. Estimated Kp values for metals/inorganics are default values recommended by EPA.

[7] Calculated using Kow for hexane as surrogate.

[8] 2-Butanone used as surrogate.

NA = Neither a Kp value nor the data needed to calculate an estimated Kp value were available.
Kow = octanol/water partition coefficient
MW = molecular weight of the analyte

ATTACHMENT 5

# ATTACHMENT 5

# EXPOSURE ASSESSMENT MODELING

This attachment presents the methods and results of the exposure modeling that was used to estimate air concentrations of VOCs that may migrate from groundwater or process water to indoor air. The estimated air concentrations calculated in the models presented in this attachment were used to quantitatively evaluate potential receptor exposures and risks.

Specifically, this attachment contains the following information:

- Migration of VOCs from groundwater to basement air (modeling methods and calculations [Table A5-1])
- Migration of VOCs from groundwater used as process water to indoor air (modeling methods and results [Table A5-2])
- Calculation of the Exposure-Point Ammonia Concentration in the Altron Wells (PTI Environmental Services)
- Henry's Law constants used in modeling (Table A5-3)
- Water quality data for Butters Row Treatment Plant

**MIGRATION OF VOCs FROM GROUNDWATER TO BASEMENT AIR**

Exposure to organic vapors that may migrate from shallow groundwater to building air was investigated for employees who may work in structures (either off-site or on-site) that overly shallow groundwater containing VOCs. Building (basement) air concentrations were estimated for current conditions and future worst-case conditions. Current conditions were estimated using the maximum VOC concentrations detected in shallow groundwater collected after December, 1994. Future worst-case conditions were estimated using the maximum VOC concentrations detected in shallow groundwater collected after December, 1991.

The potential concentrations of volatile organic compounds in buildings were estimated using a vapor diffusion model developed for the Gas Research Institute (GRI, 1988). This model however contained some units errors which were corrected. In addition, empirical data available from the literature, rather than a calculated value for the pressure differential inside and outside the foundation was used. This model is presented below. Table A5-1 calculates vapor concentrations for the off-site structure.

Vapor Intrusion Flux Model

The vapor intrusion model is based on the fact that a heated building has a temperature difference relative to its outside surroundings. The so-called chimney effect is accompanied by lowered pressure in the lower portions of the building and higher pressures in the upper portions. Thus, in particular, the basement will be at a lower pressure than the surrounding soil gases. This model assumes an intact foundation and is based on Darcy's law for fluid flow.

$$Q = \frac{C_{sg} \ x \ K_{sa} \ x \ A_f \ x \ (P_i - P_o)}{\mu \ x \ F}$$

Where:

Q = contaminant flux through the intact foundation (mg/s)

$C_{sg}$ = concentration of contaminant in soil gas, calculated as shown below from measured concentrations of contaminant in groundwater (mg/cm$^3$)

$K_{sa}$ = specific permeability of the building material to the air (cm$^2$) $5.0E\text{-}14 \leq K_{sa} \leq 5.0E\text{-}13$

$A_f$ = surface area of foundation walls and floor situated below the ground surface, determined by onsite inspection (cm$^2$)

$P_i$-$P_o$ = pressure difference between the inside and outside of the foundation (dynes/cm$^2$)

$\mu$ = dynamic viscosity of air, $\mu_{air}$ = 1.82E-04 (dynes-sec/cm$^2$)

F = foundation thickness, determined on site or estimated; F is commonly between 10 and 20 cm

$C_{sg}$ for Product Mixed in Groundwater

$C_{sg}$ = $(H/RT)C_g$ x CF

$C_g$ = Groundwater concentration (mg/mL)

p:\olin\wilmingt\hhra2\text96\vapor.txt

$H$ = Henry's Law constant (atm-m$^3$/mol)

$RT$ = Universal gas constant (8.2x10$^{5}$ atm-m3/mol-K) x temperature (K)

$CF$ = Conversion factor (1 ml/cm$^3$)

$C_{vs}$ for Floating Product

$C_{vs}$ = $P_v/RT$

$P_v$ = partial pressure

Concentration in Building

The concentration of volatile contaminants in the structure itself is calculated taking into account the rate of volatilization into the structure as well as the rate of movement of outside air through the structure. This latter rate is referred to as the air exchange rate and is expressed as air changes per hour (ACH). The ACH is the rate at which air passes into a building as the result of structural leakage (e.g., through cracks around windows and doors, through open doors, etc.). According to the National Academy of Science, the typical infiltration rates for American homes is in the range of 0.5 to 1.0 ACH (Hayes, 1991). Other studies support this assessment (Prill et al., 1990). A rate of 0.5 air changes per hour (equivalent to 12 air changes per day) was used in this assessment.

$$C_b = \frac{Q \ x \ 86{,}400 \ sec \ / \ day}{A_x \ x \ V}$$

Where:

$C$ = Concentration of contaminant in the structure (mg/m$^3$)

$A_x$ = Air exchange rate of building (0.5/hr or 12/day)

$V$ = Volume of the building (m$^3$)

# REFERENCES

Gas Research Institute (GRI), 1988. "Management of Manufactured Gas Plant Sites"; Volume III; Prepared for Gas Research Institute; Chicago, IL; Prepared by Atlantic Environmental Services, Inc.

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Turk, A., J.W. Johnston, Jr., and D.G. Moulton (eds.), 1974. "Human Responses to Environmental Odors"; New York: Academic Press.

AS-1
ORPORATION
WILMINGTON, MA FACILITY

VAPOR INTRUSION THROUGH INTACT FOUNDATION BASED ON GROUNDWATER CONCENTRATIONS
INDOOR WORKER (ON-SITE AND OFF-SITE COMBINED)
GRI MODEL 2.2.3.1 - REVISED BY ABB-ES, 5/93

INPUT PARAMETERS

| DESCRIPTION | UNITS | VARIABLE | VALUE | Source |
|---|---|---|---|---|
| contaminant flux through intact surface | mg/s | Q | | Calculated in spreadsheet |
| contaminant concentration in soil gas | $mg/cm^3$ | Csg | | Calculated in spreadsheet |
| groundwater concentration | mg/ml | Cg | | Site-specific |
| Henry's Law Constant | $atm\text{-}m^3/mol$ | H | | Table AS-3 |
| conversion factor | $ml/cm^3$ | CF | 1 | |
| concentration of contaminant in basement | $mg/m^3$ | Cb | | Calculated in spreadsheet |
| total surface area of basement walls and floor below ground ( | $cm^2$ | Af | 23225000 | Largest adjacent off-site building (200 ft. x 125 ft.) |
| thickness of foundation | cm | F | 15 | GRI, 1988 |
| indoor temperature | K | T | 295 | Assumption (72 F) |
| specific permeability of the building material to the air | $cm^2$ | Ksa | 5.00E-13 | GRI, 1988 |
| RT | $m^3\text{-}atm/mol$ | RT | 2.42E-02 | GRI, 1988 |
| pressure difference between the inside and outside of the foundation | $dynes/cm^2$ | Pi-Po | 5.00E+01 | Prill et al., 1990 |
| dynamic viscosity of air | $dynes\text{-}sec/cm^2$ | $\mu$ | 1.82E-04 | GRI, 1988 |
| air exchange rate of building | number/(day) | Ax | 12 | Hayes, 1991 |
| volume of building (2) | $m^3$ | V | 7080 | Calculated here |
| volume of air exchanged per unit time | $m^3/s$ | Va/t | 9.83E-01 | Calculated here |

Reference: Murphy, B.L., 1985; 1986, and references therein
(1) Below ground basement dimensions have been assumed to be 200 ft. x 125 ft. x 10 ft
(dimensions of building and assumed 10 ft. ceiling height).
(2) Building assumed to have one aboveground floor equal in volume to the basement.

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TABLE A5-1
OLIN CORPORATION
WILMINGTON, MA FACILITY

VAPOR INTRUSION THROUGH INTACT FOUNDATION BASED ON GROUNDWATER CONCENTRATIONS
INDOOR WORKER (ON-SITE AND OFF-SITE COMBINED)
GRI MODEL 2.2.3.1 - REVISED BY ABB-ES, 5/93

| COMPOUND | H ($m^3$-atm/mol) | Groundwater concentration [Cs (mg/ml)] Current | Worst Case | Soil Gas [Csg (mg/cm$^3$)] Current | Worst Case | Q (mg/s) Current | Worst Case |
|---|---|---|---|---|---|---|---|
| 1,1,1-Trichloroethane | 1.70E-02 | 2.00E-06 | 1.90E-05 | 1.41E-06 | 1.34E-05 | 2.99E-07 | 2.84E-06 |
| 1,1-Dichloroethane | 5.60E-03 | 2.00E-06 | 6.00E-06 | 4.63E-07 | 1.39E-06 | 9.85E-08 | 2.95E-07 |
| 1,1-Dichloroethene | 2.60E-02 | ND | 3.00E-06 | 0.00E+00 | 3.22E-06 | 0.00E+00 | 6.86E-07 |
| 1,2-Dichloroethane | 9.80E-04 | ND | NA | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| 2,4,4-Trimethyl-1-pentene | 1.03E+01 | 1.70E-04 | 3.50E-03 | 7.24E-02 | 1.49E+00 | 1.54E-02 | 3.17E-01 |
| 2,4,4-Trimethyl-2-Pentene | 1.03E+01 | 3.60E-05 | 1.20E-03 | 1.53E-02 | 5.11E-01 | 3.26E-03 | 1.09E-01 |
| 2-Butanone (MEK) | 5.60E-05 | ND | NA | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| 2-Hexanone | 2.80E-05 | 9.00E-06 | 9.00E-06 | 1.04E-08 | 1.04E-08 | 2.22E-09 | 2.22E-09 |
| 4-Methyl-2-Pentanone (MIBK) | 1.40E-04 | ND | NA | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Acetone | 3.90E-05 | 1.30E-05 | 2.00E-03 | 2.10E-08 | 3.22E-06 | 4.46E-09 | 6.86E-07 |
| Benzene | 5.60E-03 | ND | NA | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Bromodichloromethane | 1.60E-03 | ND | NA | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Bromoform | 5.80E-04 | 6.00E-06 | 2.20E-05 | 1.44E-07 | 5.27E-07 | 3.06E-08 | 1.12E-07 |
| Carbon Disulfide | 3.00E-02 | ND | 9.00E-06 | 0.00E+00 | 1.12E-05 | 0.00E+00 | 2.37E-06 |
| Chlorobenzene | 3.80E-03 | ND | NA | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Ammonia | 3.20E-04 | 2.20E-01 | 2.20E-01 | 2.91E-03 | 2.91E-03 | 6.19E-04 | 6.19E-04 |
| Dibromochloromethane | 8.70E-04 | 2.00E-06 | 7.00E-06 | 7.19E-08 | 2.52E-07 | 1.53E-08 | 5.35E-08 |
| Ethylbenzene | 8.40E-03 | ND | NA | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Methylene Chloride | 2.20E-03 | 3.00E-06 | 3.00E-06 | 2.73E-07 | 2.73E-07 | 5.80E-08 | 5.80E-08 |
| Tetrachloroethene (PCE) | 1.80E-02 | ND | NA | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Toluene | 6.60E-03 | ND | 1.00E-06 | 0.00E+00 | 2.73E-07 | 0.00E+00 | 5.80E-08 |
| Trichloroethene (TCE) | 1.00E-02 | ND | NA | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Vinyl Acetate | 5.10E-04 | ND | NA | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Xylenes, Total | 7.04E-03 | ND | NA | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |

ND = not detected in samples collected after 1/1/95.

| COMPOUND | CONCENTRATION IN BASEMENT Q (mg/s) - Current | Q (mg/s) - Worst case | Cb (mg/m$^3$) - Current | Cb (mg/m$^3$) - Worst case |
|---|---|---|---|---|
| 1,1,1-Trichloroethane | 2.99E-07 | 2.84E-06 | 3.04E-07 | 2.89E-06 |
| 1,1-Dichloroethane | 9.85E-08 | 2.95E-07 | 1.00E-07 | 3.00E-07 |
| 1,1-Dichloroethene | 0.00E+00 | 6.86E-07 | 0.00E+00 | 6.97E-07 |
| 1,2-Dichloroethane | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| 2,4,4-Trimethyl-1-pentene | 1.54E-02 | 3.17E-01 | 1.57E-02 | 3.22E-01 |
| 2,4,4-Trimethyl-2-Pentene | 3.26E-03 | 1.09E-01 | 3.32E-03 | 1.11E-01 |
| 2-Butanone (MEK) | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| 2-Hexanone | 2.22E-09 | 2.22E-09 | 2.25E-09 | 2.25E-09 |
| 4-Methyl-2-Pentanone (MIBK) | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Acetone | 4.46E-09 | 6.86E-07 | 4.53E-09 | 6.97E-07 |
| Benzene | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Bromodichloromethane | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Bromoform | 3.06E-08 | 1.12E-07 | 3.11E-08 | 1.14E-07 |
| Carbon Disulfide | 0.00E+00 | 2.37E-06 | 0.00E+00 | 2.41E-06 |
| Chlorobenzene | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Ammonia | 6.19E-04 | 6.19E-04 | 6.29E-04 | 6.29E-04 |
| Dibromochloromethane | 1.53E-08 | 5.35E-08 | 1.56E-08 | 5.45E-08 |
| Ethylbenzene | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Methylene Chloride | 5.80E-08 | 5.80E-08 | 5.90E-08 | 5.90E-08 |
| Tetrachloroethene (PCE) | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Toluene | 0.00E+00 | 5.80E-08 | 0.00E+00 | 5.90E-08 |
| Trichloroethene (TCE) | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Vinyl Acetate | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| [illegible], Total | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |

## MIGRATION OF VOCs FROM GROUNDWATER USED AS PROCESS WATER AT ALTRON CORPORATION

Altron Corporation is a manufacturer of printed circuit boards and is located approximately 500 feet west of the Olin Facility on Jewel Drive. Altron has three wells, two of which are in operation and are pumped at approximately 475,000 gallons per day (gpd) and 590,000 gpd (Personal Communication, May, 7, 1997). Altron uses groundwater from its two wells for process water and as cooling water. The process water is used as rinse water in the printed circuit board manufacturing process to wash the boards between process steps. During these processes, volatile organic chemicals (VOCs) present in the groundwater may volatilize to the ambient air within the building, whereby Altron workers may be exposed to the VOCs by breathing the building air. The purpose of this attachment is to present the techniques that were used to develop building air exposure point concentrations of the site-related VOCs present in the Altron wells. Presentation of the analytical data from sampling events at these wells, in addition to an assessment of the health risks associated with potential exposure to volatiles in the groundwater collected from these wells, is discussed in detail in the human health risk characterization.

Potential air concentrations were estimated for the VOCs that may volatilize from the rinse water tanks used by Altron (described below). To estimate air concentrations, it was assumed that the entire amount of each VOC contained in the rinse water would volatilize into the air. Based on information obtained from communications with Altron's Environmental Manager, Anthony Cigliano (personal communication, May 7, 1997), it was determined that the plant runs twenty-four hours per day, in three eight hour shifts, six days per week. All rinse water tanks are "open top" with no vents or hoods. Some tanks are agitated by air sparge and some may be heated. There are three plating lines, consisting of an Oxide line, Autoplating line, and Electroless Copper line. Of these, only the Autoplating line and Electroless Copper line use water from the wells.

The Electroless Copper line is associated with the greatest well water usage in open tanks. Typical water usage for five days would be 28,400 gpd, 28,800 gpd, 30,600 gpd, 28,100 gpd, and 25,200 gpd (average of 28,220 gpd). The room housing this line is 40 ft by 120 ft, with a ceiling 15 ft. There are three exhaust fans for this line, moving air each at 8,000 cubic feet per minute (cfm), 1,500 cfm, and 13,000 cfm for a total of 22,500 cfm. The make-up air fan draws 15,000 cfm from the outdoors; the plating line room is therefore under negative pressure. The tanks in this line are air sparged, an ammonium hydroxide-based etchant is added in operations to selectively remove copper from circuit boards, and the wastewater pH is adjusted upwards to 9.5 in three tiered tanks prior to the wastewater entering an ion-exchange or microfilter wastewater treatment process. Together, these factors favor conditions that would liberate ammonium and other VOCs from the process water.

Of the two plating lines using groundwater, it was determined that the Electroless Copper line presented worst case conditions that would result in the highest concentrations. This is because this line uses a larger amount of water, but has a lower air exchange rate (the Autoplating line uses 23,920 gpd and the room has a 50,000 cfm exhaust fan). The room that contains the Electroless Copper line is 72,000 cubic feet (2,039 cubic meters) in volume. Air is moved through the room at 22,500 cfm. Thus, air in the room has a residence time of 3.2 minutes. The average water usage is 28,200 gpd in this line, or 74.1 liters of water per minute. If one assumed that all VOC enters into the air phase immediately and comes to immediate equilibrium with the room air, then the amount of VOC that can enter the air is equal to 74.1 liters per minute x concentration of VOC in water (mg/L) x 3.2 minutes = mass of VOC (mg). This quantity of VOC is dispersed in the volume of the room, resulting in estimated average air concentration that can be calculated by dividing the mass of VOC released (mg) by the volume of the room (2,039 cubic meters).

This procedure described above for estimating indoor air concentrations of VOCs was not applied to ammonia. This is because ammonia can occur as a non-volatile ammonium ion (NH4+) or a partially volatile ammonia species (NH30). Therefore, the amount of ammonia that may be potentially released from Altron process water is dependant on the concentration of ammonia (NH30) in the Altron supply wells. The procedures used to estimate the concentraton of ammonia in groundwater entering the Altron processes, and the potential indoor air concentrations, are summarized below and described in detail in the letter report "Calculation of the Exposure-Point Ammonia Concentration in the Alron Wells" (PTI, 1997) provided as an attachment to this discussion.

The ratio of ammonium ion concentration to ammonia concentration is dependant on the pH of the water; higher pH values favor the ammonia species, and lower pH values favor the ammonium ion species. Therefore, the estimated concentrations of ammonia in Altron process water were calcualted as a function of groundwater pH using the USEPA thermodynamic model MINTEQA2. Concentrations of varioius ammonia species ($NH_3^0$, $NH_4SO_4^-$, and $NH_4^+$) were calculated from total ammonia concentrations (all chemical species) measured in the most recent round of samples (October 17, 1996) collected from each of the two Altron wells (61 mg/L and 9 mg/L in wells B1 and B3, respectively). Concentrations were calculated at various pH values to provide a range of theoretical ammonia ($NH_3^0$) concentrations. The pH levels included: (1) the pH measured in the samples collected in the most recent round of sampling (5.5 and 5.8 for wells B1 and B3, respectively); (2) the average pH values for all shallow groundwater samples (73 wells evaluated) (pH 6); and (3) the 95-percent upper confidence limit on the arithmetic mean of the pH values for all shallow groundwater samples (73 wells evaluated) (pH 7.1). Even under worst-case assumptions (well B1 at pH 7.1), the calculated ammonia concentratin (0.38 mg/L) is less than one-percent of the total ammonia species concentrations (61 mg/L).

Indoor air concentrations of ammonia were estimated by calculating the partial pressure of ammonia (NH30) above the water (i.e., the process water being used in the plating line) using the Henry's law constant for ammonia (57.5 mol/L/atm). The product of this calculation is the equilibrium ammonia air concentration. Estimated indoor air concentrations were calculated for the full range of groundwater ammonia concentrations calculated at the various pH values evaluated. The estimated indoor air concentration of ammonia range from 0.0036 ppm (well B3, pH 5.8) to 0.47 ppm (well B1, pH 7.1). These estimated indoor air concentrations represent worst-case assumptions for each groundwater concentration and pH level evaluated because the indoor air concentration cannot exceed the theoretical equilbrium concentatration. The estimated indoor air concentration of 0.47 ppm (0.33 mg/m3) ammonia was used as the building air exposure point concentration to provide a worst-case assessment that is inclusive of current and potential future exposuer conditions.

The building air exposure point concentrations of each site-related VOC detected in the Altron wells is presented in Table A5-2. These exposure point concentrations were used to evaluate risks to off-site workers as described in the human health risk characterization.

References

American Conference of Governmental Industrial Hygienists (ACGIH). 1992. Threshold Limit Values and Biological Exposure Indices for 1992-1993. Cincinnati, OH.

MADEP, 1992. "Risk Assessment Shortform Residential Exposure Scenario, Version 1.6"; Policy #WSC/ORS-142-92; Office of Research and Standards and the Bureau of Waste Site Cleanup, Boston, MA; September 1992.

PTI Environmental Services, 1997. 'Calculation of the Exposure-Point Ammonia Concentration in the Altron Wells" Letter to Mike Murphy. June 20, 1997. PTI Project No. C692-06-01.

Personal Communication, May 7, 1997. Between Anthony Cigliano, Director of Environmental Services and Peter Muto, Hazardous Chemicals and Waste Treatment Operations, Altron Corporation; Lee Wiksrom, Olin Corporation and Michael Murphy, ABB Environmental Services.

USEPA, 1989a. "Exposure Factors Handbook"; USEPA/600/8-89/043; Office of Health and Environmental Assessment, Washington, D.C.

USEPA, 1989b. "Risk Assessment Guidance for Superfund, Vol. I - Human Health Evaluation Manual (Part A); Interim Final"; USEPA/540/1-89/002; Washington, D.C.

USEPA, 1991. "Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors"; OSWER Directive 9285.6-03. Assessment, Washington, D.C.

## TABLE A5-2
## BUILDING AIR EXPOSURE POINT CONCENTRATIONS
## ALTRON WELLS PROCESS WATER (GROUNDWATER)
## CURRENT AND FUTURE LAND USE

**Olin Corporation**
**Wilmington, MA Facility**

| OHM of Concern [1] | Site Data/Concentration [2] Frequency of Detection | Minimum | Maximum | Groundwater EPC (mg/L) | Air EPC [3] ($ug/m^3$) |
|---|---|---|---|---|---|
| VOCs (mg/L) | | | | | |
| 2,4,4-Trimethyl-1-pentene | 1 / 2 | 0.004 | 0.004 | 0.004 | 0.46 |
| 2,4,4-Trimethyl-2-Pentene | 1 / 2 | 0.001 | 0.001 | 0.001 | 0.11 |
| Acetone | 1 / 2 | 0.007 | 0.007 | 0.007 | 0.81 |
| Inorganics (mg/L) | | | | | |
| Nitrogen, Ammonia | 2 / 2 | 9 | 60.7 | 60.7 | 330 |

Notes:
1 All volatile OHM potentially related to the site were included as OHM of concern.
2 Samples included in the data set include the following:
For VOCs, samples collected from wells B1 and B3 17-Oct-96.
For inorganics, samples collected from wells B1 and B3 17-Oct-96.
3 The EPC is the maximum detected groundwater concentration, modeled as an air concentration, as described in the text for "Modelling" Attachment.
EPC = Exposure Point Concentration
OHM = Oil or Hazardous Material

PTI
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June 20, 1997

Mike Murphy
ABB Environmental Services
107 Audubon Road
Wakefield, Massachusetts 01880

Subject: Calculation of the Exposure-Point Ammonia Concentration in the Altron Wells
PTI Project No. C692-06-01

Dear Mr. Murphy:

As you know, ABB Environmental Services is currently assessing the risk posed to workers at the Altron facility by the groundwater being pumped from the shallow aquifer adjacent to Olin's Wilmington facility. This water, which is used in industrial processes within the Altron facility, has historically contained elevated concentrations of ammonia (Table 1, attached). In previous calculations of risk, ABB made the conservative assumption that 100 percent of the ammonia contained in the groundwater was volatilized into a finite airspace being breathed by the Altron workers. However, geochemical modeling indicates that the vast majority of the ammonia will be present as the non-volatile ammonium ion ($NH_4^+$), rather than the partially volatile ammonia species ($NH_3^0$). Therefore, the initial calculations of risk posed by the ammonia-bearing groundwater were probably overly conservative.

As you requested, PTI calculated the maximum ammonia gas [$NH_3(g)$] concentration that would be likely to occur within the breathing zone of a worker in the Altron facility, based on the concentration of dissolved ammonia ($NH_3^0$) in the Altron well groundwaters. This analysis indicates that less than 1 percent of the ammonia in the Altron well water would be in a form more likely to volatilize, and that the breathing-zone ammonia concentrations would be unlikely to exceed 0.5 ppm, well below the NIOSH recommended exposure limit for workers of 25 ppm (v/v). The calculations on which this conclusion is based are presented below.

Details of Calculation

The analytical results from both Altron wells (Altron B1 and Altron B2; Table 1) were input into the EPA thermodynamic model MINTEQA2 to calculate the amount of ammonia ($NH_3^0$) that would be present in groundwaters at the pH levels observed in these two wells (5.5 and 5.8, respectively). Model results indicate that less than 1 percent of the total ammonia concentration would be present as $NH_3^0$ (Table 2) at the pH values measured in the Altron wells. To determine if the $NH_3^0$ concentration would increase greatly if the pH of the waters captured by the Altron wells were to increase, the model was re-run using the average and upper-95th-limit pH values observed in all the shallow groundwaters at the site (6.0 and 7.1, respectively). Model results showed that $NH_3^0$ concentrations would be higher at higher groundwater pH levels, but still would be less than 1 percent of the total ammonia concentration (Table 2).

The maximum concentration of ammonia gas that is likely to occur in air in equilibrium with groundwater can be calculated using Henry's Law:

$$P_{NH_3} = \frac{[NH_3]}{K_H}$$

where $P_{NH_3}$ is the partial pressure of ammonia gas in the air above the groundwater (in atmospheres), $[NH_3]$ is the free ammonia concentration in groundwater (in mol/L), and $K_H$ is the Henry's law constant for ammonia (57.5 mol/L/atm[1]). Using the modeled ammonia concentration, at all pH values that are likely to occur in the shallow groundwater being pumped by the Altron wells, the maximum ammonia concentration that is likely to occur in the air above this water (and thus within the Altron building) is less than 0.5 ppm (v/v) (Table 3).

It should be noted that two conservative assumptions were used in the calculations presented above:

1. It was assumed that an increase in the pH of the water being pumped by Altron would not affect the total ammonia concentration in that water. In general, however, the highest total ammonia concentrations in site groundwaters occur in the dense layer, which has a low pH (i.e., pH <4). Therefore, it is more likely that an increase in groundwater pH would be accompanied by a decrease in total ammonia concentration.

2. It was assumed that the groundwater being used in Altron's production process reaches equilibrium with the air in the building (i.e., the Henry's Law constant is valid). It is more likely, however, that confinement of the process water within Altron's plumbing, coupled with ventilation of the building, prevents such equilibrium from being reached.

[1] Morel, F.M.M., and J.G. Hering. 1993. *Principles and applications of aquatic chemistry*. John Wiley & Sons, New York (p. 181).

Given these two conservative assumptions, it is likely that the ammonia gas concentration in the breathing zone of the Altron building will remain well below the values listed in Table 3.

I hope this analysis will be useful to ABB. Should you have any questions regarding this calculation, please feel free to call me at (303) 444-7270.

Sincerely,

Christopher Sellstone

Christopher Sellstone
Geochemist

cc: Charles Swinburn (Morgan, Lewis & Bockius)
Elizabeth Perry (Smith)
Andy Davis (Geomega)
Steve Morrow (Olin)

## TABLE 1. COMPOSITION OF ALTRON WELL WATERS USED IN MINTEQA2 MODELING
**(all concentrations in mg/L, unless otherwise noted)**

| | ALTRON B1 | ALTRON B3 |
|---|---|---|
| Aluminum, dissolved | 0.48 | 0.20 |
| Bicarbonate alkalinity as $HCO_3$ | 28 | 20 |
| Calcium, dissolved | 23 | 19 |
| Chloride | 156 | 180 |
| Iron, dissolved | 0.12 | 0.10 |
| Magnesium, dissolved | 7.0 | 5.0 |
| Manganese, dissolved | 1.9 | 2.79 |
| Nitrogen, ammonia | 61 | 9.0 |
| pH Field (s.u.) | 5.5 | 5.8 |
| Potassium, dissolved | 5 | 5.3 |
| Sodium, dissolved | 75 | 70 |
| Sulfate as $SO_4$ | 316 | 87 |

Analytical data from the 10/17/97 sampling event.

**TABLE 2. PREDICTED AMMONIA SPECIES IN ALTRON WELL WATERS AS A FUNCTION OF pH (all concentrations in mg/L as N)**

| Well ID | pH | $NH_3^0$ | $NH_4SO_4^-$ | $NH_4^+$ | Total |
|---|---|---|---|---|---|
| Altron B1 | 5.5 [a] | 0.010 | 1.5 | 59 | 61 |
| | 6.0 [b] | 0.030 | 1.5 | 59 | 61 |
| | 7.1 [c] | 0.38 | 1.4 | 59 | 61 |
| Altron B3 | 5.8 [a] | 0.0029 | 0.066 | 8.9 | 9.0 |
| | 6.0 [b] | 0.0046 | 0.066 | 8.9 | 9.0 |
| | 7.1 [c] | 0.058 | 0.066 | 8.9 | 9.0 |

[a] pH value measured in sample collected on 10/17/95.
[b] Average pH value of all shallow groundwaters (73 wells evaluated).
[c] 95-percent upper confidence limit of observed pH values in shallow groundwaters (73 wells evaluated).

TABLE 3. PREDICTED MAXIMUM AMMONIA GAS CONCENTRATIONS IN BREATHING ZONE WITHIN THE ALTRON BUILDING

| Well ID | pH | Predicted $NH_3^0$ Concentration (mg/L as N)[d] | Predicted Maximum $NH_3(g)$ Concentration in Breathing Zone (ppm v/v)[e] |
|---|---|---|---|
| Altron B1 | 5.5 [a] | 0.010 | 0.012 |
| | 6.0 [b] | 0.030 | 0.037 |
| | 7.1 [c] | 0.38 | 0.47 |
| Altron B3 | 5.8 [a] | 0.0029 | 0.0036 |
| | 6.0 [b] | 0.0046 | 0.0057 |
| | 7.1 [c] | 0.058 | 0.072 |

[a] pH value measured in sample collected on 10/17/95.
[b] Average pH value of all shallow groundwaters (73 wells evaluated).
[c] 95-percent upper confidence limit of observed pH values in shallow groundwaters (73 wells evaluated).
[d] Predicted using MINTEQA2.
[e] Calculated assuming groundwater is in equilibrium with air, and that Henry's Law applies.

## TABLE A5-3
## HENRY'S LAW CONSTANTS FOR VOLATILE ORGANIC COMPOUNDS

Olin Corporation
Wilmington, MA Facility

| Volatile Organic Compound | Henry's Law Constant (atm-m$^3$/mol) | Source [1] |
|---|---|---|
| 1,1,1-Trichloroethane | 1.70E-02 | SCDM 1993 |
| 1,1,2,2-Tetrachloroethane | 4.60E-04 | SCDM 1993 |
| 1,1,2-Trichloroethane | 9.10E-04 | SCDM 1993 |
| 1,1-Dichloroethane | 5.60E-03 | SCDM 1993 |
| 1,1-Dichloroethene | 2.60E-02 | SCDM 1993 |
| 1,2-Dichloroethane | 9.80E-04 | SCDM 1993 |
| 1,2-Dichloroethene (total) [2] | 9.40E-03 | SCDM 1993 |
| 1,2-Dichloropropane | 2.80E-03 | SCDM 1993 |
| 1,3,5-Trimethylbenzene | 1.47E-01 | EPA 1987 |
| 2-Butanone | 5.60E-05 | SCDM 1993 |
| 2,4,4-Trimethyl-1-pentene [3] | 1.03E+01 | EPA 1987 |
| 2,4,4-Trimethyl-2-pentene [3] | 1.03E+01 | EPA 1987 |
| 2-Hexanone (Methyl butyl ketone) | 2.80E-05 | EPA 1990 |
| 4-Methyl-2-pentanone (MIBK - Methyl isobutyl ketone) | 1.40E-04 | SCDM 1993 |
| Acetone | 3.90E-05 | SCDM 1993 |
| Benzene | 5.60E-03 | SCDM 1993 |
| Bromodichloromethane | 1.60E-03 | SCDM 1993 |
| Bromoform | 5.80E-04 | EPA 1987 |
| Carbon Disulfide | 3.00E-02 | SCDM 1993 |
| Carbon Tetrachloride | 3.00E-02 | SCDM 1993 |
| Chlorobenzene | 3.80E-03 | SCDM 1993 |
| Chloroform | 3.70E-03 | SCDM 1993 |
| Chloromethane | 8.80E-03 | SCDM 1993 |
| cis-1,2-Dichloroethene | 4.10E-03 | SCDM 1993 |
| Dibromochloromethane | 8.70E-04 | SCDM 1993 |
| Ethyl chloride (Chloroethane) | 8.80E-03 | SCDM 1993 |
| Ethylbenzene | 8.40E-03 | SCDM 1993 |
| Hexachlorobutadiene | 8.20E-03 | SCDM 1993 |
| Methylene Chloride (Dichloromethane) | 2.20E-03 | SCDM 1993 |
| Styrene | 2.80E-03 | SCDM 1993 |
| Tetrachloroethene | 1.80E-02 | SCDM 1993 |
| Toluene | 6.60E-03 | SCDM 1993 |
| trans-1,2-Dichloroethene | 9.40E-03 | SCDM 1993 |
| Trichloroethene | 1.00E-02 | SCDM 1993 |
| Vinyl Acetate | 5.10E-04 | SCDM 1993 |
| Vinyl Chloride | 2.70E-02 | SCDM 1993 |
| Xylenes (total) | 7.04E-03 | EPA 1990 |
| Ammonia | 3.20E-04 | SCDM 1993 |

Notes:

[1] USEPA 1987. Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF) - Air Emission Models (Draft Report). Office of Air Quality Planning and Standards. April.

USEPA 1990. Basics of Pump-and-Treat Groundwater Remediation Technology. Research and Development. EPA/600/8-90/003. March.

Superfund Chemical Data Matrix (SCDM). March 1993.

[2] trans-1,2-Dichloroethene was used as a surrogate.

[3] 2-Methyl-1-pentene was used as a surrogate.

WATER QUALITY DATA

FINISHED WATER - BUTTERS ROW TREATMENT PLANT

APRIL 23, 1997

Aqueous

TABLE VO-1.0
7097-0923A
OLIN CORPORATION
TCL VOLATILE ORGANICS

All values are ug/L.

| Client Sample I.D.<br>Lab Sample I.D.<br>Method Blank I.D.<br>Quant. Factor | Method Blank<br>VBLKG8<br>VBLKG8<br>1.00 | BRTP<br>970923A-01<br>VBLKG8<br>1.00 | TB<br>970923A-02<br>VBLKG8<br>1.00 | Quant. Limits with no Dilution |
|---|---|---|---|---|
| Chloromethane | U | U | U | 10 |
| Bromomethane | U | U | U | 10 |
| Vinyl Chloride | U | U | U | 10 |
| Chloroethane | U | U | U | 10 |
| Methylene Chloride | 3J | U | U | 5.0 |
| Acetone | 4J | U | U | 10 |
| Carbon Disulfide | U | U | U | 5.0 |
| Vinyl Acetate | U | U | U | 10 |
| 1,1-Dichloroethene | U | U | U | 5.0 |
| 1,1-Dichloroethane | U | U | U | 5.0 |
| 1,2-Dichloroethene (total) | U | U | U | 5.0 |
| Chloroform | U | U | U | 5.0 |
| 1,2-Dichloroethane | U | U | U | 5.0 |
| 2-Butanone | U | U | U | 10 |
| 1,1,1-Trichloroethane | U | U | U | 5.0 |
| Carbon Tetrachloride | U | U | U | 5.0 |
| Bromodichloromethane | U | U | U | 5.0 |
| 1,2-Dichloropropane | U | U | U | 5.0 |
| cis-1,3-Dichloropropene | U | U | U | 5.0 |
| Trichloroethene | U | U | U | 5.0 |
| Dibromochloromethane | U | U | U | 5.0 |
| 1,1,2-Trichloroethane | U | U | U | 5.0 |
| Benzene | U | U | U | 5.0 |
| trans-1,3-Dichloropropene | U | U | U | 5.0 |
| Bromoform | U | U | U | 5.0 |
| 4-Methyl-2-Pentanone | U | U | U | 10 |
| 2-Hexanone | U | U | U | 10 |
| Tetrachloroethene | U | U | U | 5.0 |
| Toluene | .6J | U | U | 5.0 |
| 1,1,2,2-Tetrachloroethane | U | U | U | 5.0 |
| Chlorobenzene | U | U | U | 5.0 |
| Ethylbenzene | U | U | U | 5.0 |
| Styrene | U | U | U | 5.0 |
| Xylene (total) | U | U | U | 5.0 |
| Date Received<br>Date Extracted<br>Date Analyzed | <br>N/A<br>04/25/97 | 04/24/97<br>N/A<br>04/25/97 | 04/24/97<br>N/A<br>04/25/97 | |

See Appendix for qualifier definitions
Note: Compound detection limit = quantitation limit x quantitation factor
Quant. Factor = a numerical value which takes into account any variation in sample weight/volume, % moisture and sample dilution.

Aqueous

**TABLE AS-1.0**
**7097-0923A**
**OLIN CORPORATION**
**MISCELLANEOUS ATOMIC SPECTROSCOPY**

All values are ug/L.

| | | | | |
|---|---|---|---|---|
| Client Sample I.D. | BRTP | | | |
| Lab Sample I.D. | 970923A-01 | | | |
| Iron | 100 U | | | |
| Manganese | 33.6 | | | |

See Appendix for qualifier definitions

WET CHEM ANALYSIS DATA SHEET

SAMPLE NO.

BRTP

ame: IEA　　Contract: ______

Code: IEA　　Case No.: 0923A　　SAS No. : ______　　SDG No.: A0923

trix: (soil/water) WATER　　Lab Sample ID: 0923001

Solids: 0.0　　Date Received: 04/24/97

Concentration Units (mg/L or mg/kg dry weight) : mg/L

| Analyte | Concentration | C | Q | M |
|---|---|---|---|---|
| AMMONIA | 1.85 | | | AS |
| CHLORIDE | 78.4 | | | AS |
| SULFATE | 79.5 | | | AS |
| TDS | 268. | | | G |

mments: ______

FORM I - WC

**WATER QUALITY SUMMARIES - RAW AND FINISHED WATER**

**BUTTERS ROW TREATMENT PLANT LABORATORY**

**SAMPLED APRIL 20 - 26, 1997 AND MAY 18-24, 1997**

## Water Quality

Location: Butters Row WTP

| | | Sunday | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday |
|---|---|---|---|---|---|---|---|---|
| Day: | | Sunday | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday |
| Date: | | 5/18/97 | 5/19/97 | 5/20/97 | 5/21/97 | 5/22/97 | 5/23/97 | 5/24/97 |
| Time: | | 12:40pm | 10:30 | 3:30 | 3:30 | 3:30 | 11:30 | 8:00 |
| Flow: | | 800 | 1800 | 800 | 800 | 800 | 800 | 800 |
| Operator: | | Cliff | MARK | MARK | MARK | MARK | MARK | [illegible] |
| Finish | pH | 8.5 | 9.0 | OFF - LINE | OFF - LINE | 8.6 | 8.5 | 8.6 |
| | Chlorine T | 2.76 | 3.34 | 3.30 | 2.68 | 2.86 | 2.94 | |
| | F | .27 | 0.20 | 0.26 | 0.32 | 0.21 | 0.21 | 0.23 |
| | Fe | .01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.02 | |
| | Mn | | 0.130 | 0.097 | 0.092 | 0.087 | 0.088 | |
| | Turbidity | .34 | | 0.36 | 0.28 | 0.31 | 0.44 | |
| | Color A | 2 | | 2 | 1 | 1 | 2 | |
| | Al | | | | | | | |
| | Cu | | | | | | | |
| | Other | | | | | | | |
| Raw | pH | 6.2 | | 6.3 | 6.2 | 6.3 | 6.3 | |
| | Fe | 4.82 | | 4.28 | 4.15 | 4.19 | 3.66 | |
| | Mn | | | 0.694 | 0.647 | 0.609 | 0.487 | |
| | Turbidity | | | | | | 3.5 | |
| | Color A | 50+ | | 50+ | 50+ | 50+ | 50+ | |
| | Al | | | | | | | |
| | Cu | | | | | | | |
| | CO2 | | | | | | | |
| | Other | | | | | | | |
| Post Aeration | pH | | 7.2 | 7.2 | 7.2 | 7.2 | 6.9 | |
| | Turbidity | | | 4.9 | 4.7 | 4.9 | | |
| | CO2 | | | | | | | |
| Flash Mixers | pH 1 | | 7.3 | 7.2 | 7.1 | 7.2 | | |
| | 2 | | 7.3 | 7.3 | 7.1 | 7.2 | 7.0 | |
| Sed Basins | Turbidity 1 | | | 1.4 | 1.4 | 1.5 | 1.2 | |
| | 2 | | | 1.4 | 1.5 | 1.6 | 1.2 | |
| | Color 1 | | | 15 | 18 | 14 | 11 | |
| | 2 | | | 15 | 14 | 19 | 11 | |
| Lagoon | pH | | NE | NE | 7.2 | 7.4 | 7.6 | |
| | Fe | | | | | | | |
| | Mn | | | | | | | |
| | Al | | | | | | | |

## Water Quality

Location: Butters Row WTP

| Day: | | Sunday | Monday | Tuesday | Wednesday | Thursday | Friday | Saturday |
|---|---|---|---|---|---|---|---|---|
| Date: | | 4/20/97 | 4/21/97 | 4/22/97 | 4/23/97 | 4/24/97 | 4/25/97 | 4/26/97 |
| Time: | | 12:20 | 11:00 | 1:00 | 1:00 | 8:20 AM | 8:30 AM | 11:15 |
| Flow: | | 1600 | 1600 | 1600 | 1600 | 1,600 GPM | 800 GPM | 800 |
| Operator: | | DS | MARK | MARK | MARK | Cliff | Cliff | DAVE |
| Finish | pH | 8.8 | 9.0 | 8.9 | | 7.7 | 8.5 | 8.6 |
| | Chlorine T | .22 | ~~0.20~~ | 2.12 | 1.84 | 2.86 | 2.24 | |
| | F | | 0.20 | 0.21 | 0.20 | .35 | 0.26 | 0.20 |
| | Fe | | | 0.01 | 0.03 | .04 | .02 | |
| | Mn | | | 0.030 | 0.067 | 0.131 | 0.122 | |
| | Turbidity | | | 0.35 | 0.21 | .24 | .30 | |
| | Color | | | 4 | 4 | 3 | 2 | |
| | Al | | | | | | | |
| | Cu | | | | | | | |
| | Other | | | | | | | |
| Raw | pH | | | 6.2 | 6.3 | 6.1 | 6.1 | |
| | Fe | | | 4.48 | 3.28 | 3.32 | 2.34 | |
| | Mn | | | 0.569 | 0.702 | .698 | .704 | |
| | Turbidity | | | 4.7 | 2.7 | 1.3 | 1.7 | |
| | Color | | | +50 | +50 | 47 | 38 | |
| | Al | | | | | | | |
| | Cu | | | | | | | |
| | CO2 | | | | | | | |
| | Other | | | | | | | |
| Post Aeration | pH | | | 7.2 | 7.2 | | | |
| | Turbidity | | | 5.4 | 6.7 | | | |
| | CO2 | | | | | | | |
| Flash Mixers | pH 1 | | | 7.3 | 7.3 | 7.3 | 7.2 | |
| | 2 | | | 7.2 | 7.3 | 7.25 | 7.0 | |
| Sed Basins | Turbidity 1 | | | 1.6 | 1.7 | 2.0 | 1.0 | |
| | 2 | | | 1.5 | 1.7 | 1.7 | 1.1 | |
| | Color 1 | | | 28 | 28 | 26 | 18 | |
| | 2 | | | 28 | 26 | 22 | 19 | |
| Lagoon | pH | | N.E. | 7.9 | 7.4 | 7.6 | 7.3 | |
| | Fe | | | | | | | |
| | Mn | | | | | | | |
| | Al | | | | | | | |

ATTACHMENT 6

# ATTACHMENT 6

# SURFACE SOIL RISK CALCULATION SPREADSHEETS

MWSSIDSL
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SURFACE SOIL - SULFATE LANDFILL
RECEPTOR: ON-SITE WORKER (PLANT B AREA AND MAINTENANCE ) - CURRENT LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-1

22-May-97

EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| CONCENTRATION SOIL | $[OHM]_{soil}$ | chemical specific | chemical-specific | |
| INGESTION RATE | IR | 50 | mg-soil/day | MADEP, 1995 |
| ADHERENCE FACTOR | AF | 0.51 | mg-soil/cm²-skin | MADEP, 1995 |
| AVERAGE SURFACE AREA (1) | SA | 5,200 | cm²/day | calculated per MADEP, 1995 |
| RELATIVE ABSORPTION FACTOR-ORAL | RAF-O | chemical specific | unitless | MADEP, 1994, 1995 |
| RELATIVE ABSORPTION FACTOR -DERM | RAF-D | chemical specific | unitless | MADEP, 1994, 1995 |
| CONVERSION FACTOR | CF | 1.00E-06 | kg/mg | |
| BODY WEIGHT | BW | 70 | kg | USEPA, 1989 |
| EXPOSURE PERIOD | EP | 25 | years | USEPA, 1991 |
| EXPOSURE FREQUENCY (2) | EF | 3 | events/year | Assumption |
| EXPOSURE DURATION (2) | ED | 6 | day/event | Assumption |
| AVERAGING PERIOD | | | | |
| CANCER | AP | 75 | years | MADEP, 1995 |
| NONCANCER | AP | 25 | years | USEPA, 1991 |

(1) 50th percentile of surface areas for males: head, hands, arms.
(2) 3 events per year, 12 hours per event, at a rate of 2 hours per day (=6 days per event). These data are based on an interview with facility personnel (9/24/96)


MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
MADEP, 1995. Guidance for Disposal Site Risk Characterization. Interim Final Policy WSC/ORS-95-141. July 1995.
USEPA, 1989. Exposure Factors Handbook EPA/600/8-89/043. May 1989.
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors." OSWER Directive 9285.6-03.


EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)^-1

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE-INGESTION} = \frac{[OHM]_{soil} \times IR \times RAF\text{-}O \times CF \times EF \times ED \times EP}{BW \times AP \times 365\ \text{days/yr}}$$

$$\text{INTAKE-DERMAL} = \frac{[OHM]_{soil} \times SA \times AF \times RAF\text{-}D \times EF \times ED \times EP \times CF}{BW \times AP \times 365\ \text{days/yr}}$$

MWSSIDSL
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SURFACE SOIL - SULFATE LANDFILL
RECEPTOR: ON-SITE WORKER (PLANT B AREA AND MAINTENANCE ) - CURRENT LAND USE
OLIN CORPORATION
*WILMINGTON, MA FACILITY*
TABLE A6-1

22-May-97

CARCINOGENIC EFFECTS

| | SOIL CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | CANCER SLOPE FACTOR (mg/kg-day)^-1 | CANCER RISK INGESTION | CANCER RISK DERMAL | TOTAL CANCER RISK |
|---|---|---|---|---|---|---|---|---|---|
| Benzo(a)Anthracene | 0.038 | 1.00 | 4.5E-10 | 0.20 | 4.7E-09 | 7.3E-01 | 3.3E-10 | 3.5E-09 | 3.8E-09 |
| Benzo(a)Pyrene | 0.046 | 1.00 | 5.4E-10 | 0.20 | 5.7E-09 | 7.3E+00 | 3.9E-09 | 4.2E-08 | 4.6E-08 |
| Benzo(b)Fluoranthene | 0.0665 | 1.00 | 7.8E-10 | 0.20 | 8.3E-09 | 7.3E-01 | 5.7E-10 | 6.0E-09 | 6.6E-09 |
| Benzo(k)Fluoranthene | 0.018 | 1.00 | 2.1E-10 | 0.20 | 2.2E-09 | 7.3E-02 | 1.5E-11 | 1.6E-10 | 1.8E-10 |
| Chrysene | 0.0445 | 1.00 | 5.2E-10 | 0.20 | 5.5E-09 | 7.3E-03 | 3.8E-12 | 4.0E-11 | 4.4E-11 |
| Indeno (1,2,3-cd)Pyrene | 0.047 | 1.00 | 5.5E-10 | 0.20 | 5.9E-09 | 7.3E-01 | 4.0E-10 | 4.3E-09 | 4.7E-09 |
| bis(2-EthylHexyl)phthalate | 0.083 | 1.00 | 9.7E-10 | 0.02 | 1.0E-09 | 1.4E-02 | 1.4E-11 | 1.4E-11 | 2.8E-11 |
| Arsenic | 8.0333 | 1.00 | 9.4E-08 | 0.03 | 1.5E-07 | 1.5E+00 | 1.4E-07 | 2.3E-07 | 3.7E-07 |
| Lead | 28.5 | | | | | ND | | | |
| | | | | | SUMMARY CANCER RISK | | 1E-07 | 3E-07 | 4E-07 |

[1] MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
ND = no data available

MWSSIDSL
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SURFACE SOIL - SULFATE LANDFILL
RECEPTOR: ON-SITE WORKER (PLANT B AREA AND MAINTENANCE ) - CURRENT LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-1

22-May-97

NONCARCINOGENIC EFFECTS

| COMPOUND | SOIL CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|
| Toluene | 0.003 | 1.00 | 1.1E-10 | 0.12 | 6.7E-10 | 2.0E-01 | 5.3E-10 | 3.4E-09 | 3.9E-09 |
| Benzo(a)Anthracene | 0.038 | 0.91 | 1.2E-09 | 0.18 | 1.3E-08 | 3.0E-02 | 4.1E-08 | 4.3E-07 | 4.7E-07 |
| Benzo(a)Pyrene | 0.046 | 0.91 | 1.5E-09 | 0.18 | 1.5E-08 | 3.0E-02 | 4.9E-08 | 5.2E-07 | 5.6E-07 |
| Benzo(b)Fluoranthene | 0.0665 | 0.91 | 2.1E-09 | 0.18 | 2.2E-08 | 3.0E-02 | 7.1E-08 | 7.5E-07 | 8.2E-07 |
| Benzo(g,h,i)Perylene | 0.029 | 0.91 | 9.3E-10 | 0.18 | 9.8E-09 | 3.0E-02 | 3.1E-08 | 3.3E-07 | 3.6E-07 |
| Benzo(k)Fluoranthene | 0.018 | 0.91 | 5.8E-10 | 0.18 | 6.1E-09 | 3.0E-02 | 1.9E-08 | 2.0E-07 | 2.2E-07 |
| Chrysene | 0.0445 | 0.91 | 1.4E-09 | 0.18 | 1.5E-08 | 3.0E-02 | 4.8E-08 | 5.0E-07 | 5.5E-07 |
| Di-n-butylphthalate | 0.017 | 0.96 | 5.7E-10 | 0.18 | 5.7E-09 | 1.0E-01 | 5.7E-09 | 5.7E-08 | 6.3E-08 |
| Fluoranthene | 0.0825 | 1.00 | 2.9E-09 | 0.20 | 3.1E-08 | 4.0E-02 | 7.3E-08 | 7.7E-07 | 8.4E-07 |
| Indeno (1,2,3-cd)Pyrene | 0.047 | 0.91 | 1.5E-09 | 0.18 | 1.6E-08 | 3.0E-02 | 5.0E-08 | 5.3E-07 | 5.8E-07 |
| Phenanthrene | 0.042 | 0.91 | 1.3E-09 | 0.18 | 1.4E-08 | 3.0E-02 | 4.5E-08 | 4.7E-07 | 5.2E-07 |
| Pyrene | 0.063 | 1.00 | 2.2E-09 | 0.20 | 2.4E-08 | 3.0E-02 | 7.4E-08 | 7.8E-07 | 8.6E-07 |
| bis(2-EthylHexyl)phthalate | 0.083 | 1.00 | 2.9E-09 | 0.02 | 3.1E-09 | 2.0E-02 | 1.5E-07 | 1.6E-07 | 3.0E-07 |
| Aluminum | 4826.6667 | | | | | | | | |
| Arsenic | 8.0333 | 1.00 | 2.8E-07 | 0.03 | 4.5E-07 | 3.0E-04 | 9.4E-04 | 1.5E-03 | 2.4E-03 |
| Barium | 13.9167 | 0.71 | 3.5E-07 | 0.05 | 1.4E-06 | 7.0E-02 | 5.0E-06 | 2.0E-05 | 2.5E-05 |
| Calcium | 627.1833 | | | | | | | | |
| Chromium III | 15.75 | 1.00 | 5.5E-07 | 0.04 | 1.2E-06 | 1.0E+00 | 5.5E-07 | 1.2E-06 | 1.7E-06 |
| Chromium VI | 1.75 | 1.00 | 6.2E-08 | 0.09 | 2.9E-07 | 5.0E-03 | 1.2E-05 | 5.9E-05 | 7.1E-05 |
| Cobalt | 2.5417 | 1.86 | 1.7E-07 | 0.14 | 6.8E-07 | 1.8E-01 | 9.2E-07 | 3.8E-06 | 4.7E-06 |
| Iron | 6990 | | | | | | | | |
| Lead | 28.5 | 0.50 | 5.0E-07 | 0.01 | 3.2E-07 | 7.5E-04 | 6.7E-04 | 4.3E-04 | 1.1E-03 |
| Manganese | 109.15 | 1.86 | 7.1E-06 | 0.14 | 2.9E-05 | 4.7E-02 | 1.5E-04 | 6.2E-04 | 7.7E-04 |
| Nickel | 4.1 | 1.00 | 1.4E-07 | 0.35 | 2.7E-06 | 2.0E-02 | 7.2E-06 | 1.3E-04 | 1.4E-04 |
| Selenium | 0.5175 | 1.00 | 1.8E-08 | 0.00 | 1.9E-09 | 5.0E-03 | 3.6E-06 | 3.9E-07 | 4.0E-06 |

[1] MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.

ND = no data available

MWSSIDSL
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SURFACE SOIL - SULFATE LANDFILL
RECEPTOR: ON-SITE WORKER (PLANT B AREA AND MAINTENANCE ) - CURRENT LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-1

22-May-97
NONCARCINOGENIC EFFECTS (CONTINUED)

| | SOIL CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|
| Sodium | 37 | | | | | | | | |
| Thallium | 0.66 | 1.00 | 2.3E-08 | 0.01 | 1.2E-08 | 8.0E-05 | 2.9E-04 | 1.5E-04 | 4.4E-04 |
| Vanadium | 14.8333 | 0.71 | 3.7E-07 | 0.05 | 1.5E-06 | 7.0E-03 | 5.3E-05 | 2.2E-04 | 2.7E-04 |
| Zinc | 22.5167 | 1.00 | 7.9E-07 | 0.02 | 8.4E-07 | 3.0E-01 | 2.6E-06 | 2.8E-06 | 5.4E-06 |
| Chloride | 61.5 | | | | | | | | |
| Nitrogen, Ammonia | 17 | 0.71 | 4.2E-07 | 0.05 | 1.7E-06 | 3.7E-01 | 1.1E-06 | 4.7E-06 | 5.8E-06 |
| Sulfate as SO4 | 30.5 | | | | | | | | |
| | | | | | SUMMARY HAZARD INDEX | | 2E-03 | 3E-03 | 5E-03 |

[1] MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
ND = no data available

MWSSINSL
INHALATION EXPOSURE TO OHM IN SURFACE SOIL PARTICULATES - SULFATE LANDFILL
RECEPTOR: ON-SITE WORKER (PLANT B AREA AND MAINTENANCE) - CURRENT LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-2

22-May-97

EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| CONCENTRATION IN AIR | [RP]air | 32 | ug/m3 | MADEP, 1995 |
| CONCENTRATION IN SOIL | [OHM]part | chemical-specific | mg/kg | |
| CONVERSION FACTOR 1 | CF1 | 24 | hours/day | |
| EXPOSURE TIME DAILY (1) | ET | 2 | hours/day | Assumption |
| EXPOSURE FREQUENCY (2) | EF | 18 | days/year | Assumption |
| EXPOSURE DURATION | ED | 25 | years | USEPA, 1991 |
| CONVERSION FACTOR 2 | CF2 | 365 | days/year | |
| CONVERSION FACTOR 3 | CF3 | 0.000001 | kg/mg | |
| AVERAGING TIME CANCER | AT | 75 | years | MADEP, 1995 |
| AVERAGING TIME NONCANCER | AT | 25 | years | USEPA, 1991 |

(1) 12 hours per event, with each event occurring over a 6 day period (=12 hours per event/6 days per event=2 hours per day). Based on interview (9/24/96).
(2) 3 events per year, with each event occurring over a 6 day period (= 18 days per year). Based on interview (9/24/96).


MADEP, 1995. Guidance for Disposal Site Risk Characterization, Interim Final Policy WSC/ORS-95-141. July.
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors." OSWER Directive 9285.6-03.


EQUATIONS

CANCER RISK = AVG. CONC. (ug/m3) * CANCER UNIT RISK (ug/m3)^-1

HAZARD QUOTIENT = AVG.CONC.(ug/m3)/REF. CONC. (ug/m3)

$$\text{AVG. EXPOSURE CONC.} = \frac{[OHM]air * EF * ET * ED}{AT * CF1 * CF2}$$

OHM AIR CONC. = [RP]air * [OHM]part * CF3

Note:
*For noncarcinogenic effects: AT = ED

MWSSINSL
INHALATION EXPOSURE TO OHM IN SURFACE SOIL PARTICULATES - SULFATE LANDFILL
RECEPTOR: ON-SITE WORKER (PLANT B AREA AND MAINTENANCE ) - CURRENT LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-2

23-May-97

CARCINOGENIC EFFECTS

| COMPOUND | OHM SOIL CONCENTRATION (mg/kg) | OHM AIR CONCENTRATION (ug/m3) | AVERAGE AIR CONCENTRATION LIFETIME (ug/m3) | INHALATION CANCER UNIT RISK (ug/m3)^-1 | CANCER RISK |
|---|---|---|---|---|---|
| Benzo(a)Anthracene | 0.038 | 0.000001216 | 1.7E-09 | 1.1E-04 | 1.8E-13 |
| Benzo(a)Pyrene | 0.046 | 0.000001472 | 2.0E-09 | 1.1E-03 | 2.2E-12 |
| Benzo(b)Fluoranthene | 0.0665 | 0.000002128 | 2.9E-09 | 1.1E-04 | 3.2E-13 |
| Benzo(k)Fluoranthene | 0.018 | 0.000000576 | 7.9E-10 | 1.1E-05 | 8.7E-15 |
| Chrysene | 0.0445 | 0.000001424 | 2.0E-09 | 1.1E-06 | 2.1E-15 |
| Indeno (1,2,3-cd)Pyrene | 0.047 | 0.000001504 | 2.1E-09 | 1.1E-04 | 2.3E-13 |
| bis(2-EthylHexyl)phthalate | 0.083 | 0.000002656 | 3.6E-09 | 2.4E-06 | 8.7E-15 |
| Arsenic | 8.0333 | 0.000257066 | 3.5E-07 | 4.3E-03 | 1.5E-09 |
| Chromium VI | 1.75 | 0.000056 | 7.7E-08 | 1.2E-02 | 9.2E-10 |
| Lead | 28.5 | 0.000912 | 1.2E-06 | ND | |
| Nickel | 4.1 | 0.0001312 | 1.8E-07 | 2.4E-04 | 4.3E-11 |
| # | | | SUMMARY CANCER RISK | | 2E-09 |

ND = No data available.

MWSSINSL
INHALATION EXPOSURE TO OHM IN SURFACE SOIL PARTICULATES - SULFATE LANDFILL
RECEPTOR: ON-SITE WORKER (PLANT B AREA AND MAINTENANCE ) - CURRENT LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-2

22-May-97

NONCARCINOGENIC EFFECTS

| COMPOUND | OHM SOIL CONCENTRATION mg/kg | OHM AIR CONCENTRATION (ug/m³) | AVERAGE AIR CONCENTRATION FOR TIME PERIOD (ug/m3) | CHRONIC INHALATION RfC [1] (ug/m3) | HAZARD QUOTIENT |
|---|---|---|---|---|---|
| Toluene | 0.003 | 0.000000096 | 3.9E-10 | 400 | 9.9E-13 |
| Benzo(a)Anthracene | 0.038 | 0.000001216 | 5.0E-09 | 71 | 7.0E-11 |
| Benzo(a)Pyrene | 0.046 | 0.000001472 | 6.0E-09 | 71 | 8.5E-11 |
| Benzo(b)Fluoranthene | 0.0665 | 0.000002128 | 8.7E-09 | 71 | 1.2E-10 |
| Benzo(g,h,i)Perylene | 0.029 | 0.000000928 | 3.8E-09 | 71 | 5.4E-11 |
| Benzo(k)Fluoranthene | 0.018 | 0.000000576 | 2.4E-09 | 71 | 3.3E-11 |
| Chrysene | 0.0445 | 0.000001424 | 5.9E-09 | 71 | 8.2E-11 |
| Di-n-butylphthalate | 0.017 | 0.000000544 | 2.2E-09 | 7 | 3.2E-10 |
| Fluoranthene | 0.0825 | 0.00000264 | 1.1E-08 | 71 | 1.5E-10 |
| Indeno (1,2,3-cd)Pyrene | 0.047 | 0.000001504 | 6.2E-09 | 71 | 8.7E-11 |
| Phenanthrene | 0.042 | 0.000001344 | 5.5E-09 | 71 | 7.8E-11 |
| Pyrene | 0.063 | 0.000002016 | 8.3E-09 | 71 | 1.2E-10 |
| bis(2-EthylHexyl)phthalate | 0.083 | 0.000002656 | 1.1E-08 | 7 | 1.6E-09 |
| Aluminum | 4826.6667 | 0.154453334 | 6.3E-04 | | |
| Arsenic | 8.0333 | 0.000257066 | 1.1E-06 | 0.0025 | 4.2E-04 |
| Barium | 13.9167 | 0.000445334 | 1.8E-06 | 0.5 | 3.7E-06 |
| Calcium | 627.1833 | 0.020069866 | 8.2E-05 | | |
| Chromium III | 15.75 | 0.000504 | 2.1E-06 | 6.8 | 3.0E-07 |
| Chromium VI | 1.75 | 0.000056 | 2.3E-07 | 0.02 | 1.2E-05 |
| Cobalt | 2.5417 | 8.13344E-05 | 3.3E-07 | | |
| Iron | 6990 | 0.22368 | 9.2E-04 | | |
| Lead | 28.5 | 0.000912 | 3.7E-06 | 0.7 | 5.4E-06 |
| Manganese | 109.15 | 0.0034928 | 1.4E-05 | 0.05 | 2.9E-04 |
| Nickel | 4.1 | 0.0001312 | 5.4E-07 | 0.009 | 6.0E-05 |
| Selenium | 0.5175 | 0.00001656 | 6.8E-08 | 2.7 | 2.5E-08 |

MWSSINSL
INHALATION EXPOSURE TO OHM IN SURFACE SOIL PARTICULATES - SULFATE LANDFILL
RECEPTOR: ON-SITE WORKER (PLANT B AREA AND MAINTENANCE ) - CURRENT LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-2

22-May-97
NONCARCINOGENIC EFFECTS

| COMPOUND | OHM SOIL CONCENTRATION mg/kg | OHM AIR CONCENTRATION (ug/m³) | AVERAGE AIR CONCENTRATION FOR TIME PERIOD (ug/m3) | CHRONIC INHALATION RfC [1] (ug/m3) | HAZARD QUOTIENT |
|---|---|---|---|---|---|
| Sodium | 37 | 0.001184 | 4.9E-06 | | |
| Thallium | 0.66 | 0.00002112 | 8.7E-08 | | |
| Vanadium | 14.8333 | 0.000474666 | 2.0E-06 | 1.4 | 1.4E-06 |
| Zinc | 22.5167 | 0.000720534 | 3.0E-06 | | |
| Chloride | 61.5 | 0.001968 | 8.1E-06 | | |
| Nitrogen, Ammonia | 17 | 0.000544 | 2.2E-06 | 100 | 2.2E-08 |
| Sulfate as SO4 | 30.5 | 0.000976 | 4.0E-06 | | |
| | | | SUMMARY HAZARD INDEX | | 8E-04 |

ND = No data available.

MWSSIDAL
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SURFACE SOIL - ENTIRE SITE (EXLUDING SULFATE LANDFILL)
RECEPTOR: ON-SITE WORKER (PLANT B AREA AND MAINTENANCE ) - CURRENT LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-3

09-Jun-97

EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| CONCENTRATION SOIL | $[OHM]_{soil}$ | chemical specific | chemical-specific | |
| INGESTION RATE | IR | 50 | mg-soil/day | MADEP, 1995 |
| ADHERENCE FACTOR | AF | 0.51 | mg-soil/cm²-skin | MADEP, 1995 |
| AVERAGE SURFACE AREA (1) | SA | 5,200 | cm²/day | calculated per MADEP, 1995 |
| RELATIVE ABSORPTION FACTOR-ORAL | RAF-O | chemical specific | unitless | MADEP, 1994, 1995 |
| RELATIVE ABSORPTION FACTOR -DERM | RAF-D | chemical specific | unitless | MADEP, 1994, 1995 |
| CONVERSION FACTOR | CF | 1.00E-06 | kg/mg | |
| BODY WEIGHT | BW | 70 | kg | USEPA, 1989 |
| EXPOSURE PERIOD | EP | 25 | years | USEPA, 1991 |
| EXPOSURE FREQUENCY (2) | EF | 3 | events/year | Assumption |
| EXPOSURE DURATION (2) | ED | 6 | day/event | Assumption |
| AVERAGING PERIOD | | | | |
| CANCER | AP | 75 | years | MADEP, 1995 |
| NONCANCER | AP | 25 | years | USEPA, 1991 |

(1) 50th percentile of surface areas for males: head, hands, arms.
(2) 3 events per year, 12 hours per event, at a rate of 2 hours per day (=6 days per event). These data are based on an interview with facility personnel (9/24/96).
MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
MADEP, 1995. Guidance for Disposal Site Risk Characterization. Interim Final Policy WSC/ORS-95-141. July 1995.
USEPA, 1989. Exposure Factors Handbook. EPA/600/8-89/043. May 1989.
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors." OSWER Directive 9285.6-03.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)^-1

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE-INGESTION} = \frac{[OHM]soil \times IR \times RAF\text{-}O \times CF \times EF \times ED \times EP}{BW \times AP \times 365\ days/yr}$$

$$\text{INTAKE-DERMAL} = \frac{[OHM]soil \times SA \times AF \times RAF\text{-}D \times EF \times ED \times EP \times CF}{BW \times AP \times 365\ days/yr}$$

MWSSIDAL
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SURFACE SOIL - ENTIRE SITE (EXLUDING SULFATE LANDFILL)
RECEPTOR: ON-SITE WORKER (PLANT B AREA AND MAINTENANCE ) - CURRENT LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-3

09-Jun-97

CARCINOGENIC EFFECTS

| | SOIL CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | CANCER SLOPE FACTOR (mg/kg-day)^-1 | CANCER RISK INGESTION | CANCER RISK DERMAL | TOTAL CANCER RISK |
|---|---|---|---|---|---|---|---|---|---|
| 1,1-Dichloroethene | 0.0009804 | 1.02 | 1.2E-11 | 0.10 | 6.2E-11 | 6.0E-01 | 7.0E-12 | 3.7E-11 | 4.4E-11 |
| Methylene Chloride | 0.002680076 | 1.00 | 3.1E-11 | 0.10 | 1.7E-10 | 7.5E-03 | 2.4E-13 | 1.3E-12 | 1.5E-12 |
| Tetrachloroethene (PCE) | 0.00187224 | 1.00 | 2.2E-11 | 0.10 | 1.2E-10 | 5.1E-02 | 1.1E-12 | 5.9E-12 | 7.1E-12 |
| 2-Methylphenol (o-Cresol) | 0.0060515 | | | | | ND | | | |
| Benzo(a)Anthracene | 0.97406979 | 1.00 | 1.1E-08 | 0.20 | 1.2E-07 | 7.3E-01 | 8.3E-09 | 8.9E-08 | 9.7E-08 |
| Benzo(a)Pyrene | 0.71003095 | 1.00 | 8.3E-09 | 0.20 | 8.8E-08 | 7.3E+00 | 6.1E-08 | 6.5E-07 | 7.1E-07 |
| Benzo(b)Fluoranthene | 0.456302246 | 1.00 | 5.4E-09 | 0.20 | 5.7E-08 | 7.3E-01 | 3.9E-09 | 4.1E-08 | 4.5E-08 |
| Benzo(k)Fluoranthene | 0.5212271 | 1.00 | 6.1E-09 | 0.20 | 6.5E-08 | 7.3E-02 | 4.5E-10 | 4.7E-09 | 5.2E-09 |
| Butylbenzylphthalate | 0.193246212 | | | | | ND | | | |
| Chrysene | 1.095360584 | 1.00 | 1.3E-08 | 0.20 | 1.4E-07 | 7.3E-03 | 9.4E-11 | 1.0E-09 | 1.1E-09 |
| Indeno (1,2,3-cd)Pyrene | 0.25962265 | 1.00 | 3.0E-09 | 0.20 | 3.2E-08 | 7.3E-01 | 2.2E-09 | 2.4E-08 | 2.6E-08 |
| N-Nitrosodiphenylamine | 1.051156552 | 0.91 | 1.1E-08 | 0.17 | 1.1E-07 | 4.9E-03 | 5.5E-11 | 5.5E-10 | 6.0E-10 |
| bis(2-Ethylhexyl)phthalate | 37.72849104 | 1.00 | 4.4E-07 | 0.02 | 4.7E-07 | 1.4E-02 | 6.2E-09 | 6.6E-09 | 1.3E-08 |
| 4,4'-DDD | 0.013510286 | 1.00 | 1.6E-10 | 0.20 | 1.7E-09 | 2.4E-01 | 3.8E-11 | 4.0E-10 | 4.4E-10 |
| 4,4'-DDE | 0.01495768 | 1.00 | 1.8E-10 | 0.20 | 1.9E-09 | 3.4E-01 | 6.0E-11 | 6.3E-10 | 6.9E-10 |
| 4,4'-DDT | 0.096925784 | 1.00 | 1.1E-09 | 0.20 | 1.2E-08 | 3.4E-01 | 3.9E-10 | 4.1E-09 | 4.5E-09 |
| Aldrin | 0.00081635 | 1.00 | 9.6E-12 | 0.25 | 1.3E-10 | 1.7E+01 | 1.6E-10 | 2.2E-09 | 2.3E-09 |
| Alpha-BHC | 0.001541392 | 0.96 | 1.7E-11 | 0.18 | 1.7E-10 | 6.3E+00 | 1.1E-10 | 1.1E-09 | 1.2E-09 |
| Alpha-Chlordane | 0.001231571 | 1.00 | 1.4E-11 | 0.05 | 3.8E-11 | 1.3E+00 | 1.9E-11 | 5.0E-11 | 6.9E-11 |
| Dieldrin | 0.000780928 | 1.00 | 9.2E-12 | 0.25 | 1.2E-10 | 1.6E+01 | 1.5E-10 | 1.9E-09 | 2.1E-09 |
| Gamma-BHC (Lindane) | 0.007240963 | 1.00 | 8.5E-11 | 0.20 | 9.0E-10 | 1.3E+00 | 1.1E-10 | 1.2E-09 | 1.3E-09 |
| Gamma-Chlordane | 0.001274346 | 1.00 | 1.5E-11 | 0.05 | 4.0E-11 | 1.3E+00 | 1.9E-11 | 5.2E-11 | 7.1E-11 |
| Heptachlor | 0.000056654 | 1.00 | 6.7E-13 | 0.20 | 7.1E-12 | 4.5E+00 | 3.0E-12 | 3.2E-11 | 3.5E-11 |
| Heptachlor Epoxide | 0.0001206 | 1.00 | 1.4E-12 | 0.20 | 1.5E-11 | 9.1E+00 | 1.3E-11 | 1.4E-10 | 1.5E-10 |
| PCB-1016 | 0.0156408 | 0.85 | 1.6E-10 | 0.07 | 6.8E-10 | 2.0E+00 | 3.1E-10 | 1.4E-09 | 1.7E-09 |
| Arsenic | 9.554368578 | 1.00 | 1.1E-07 | 0.03 | 1.8E-07 | 1.5E+00 | 1.7E-07 | 2.7E-07 | 4.4E-07 |
| Beryllium | 0.037884618 | 1.00 | 4.4E-10 | 0.03 | 7.1E-10 | 4.3E+00 | 1.9E-09 | 3.0E-09 | 5.0E-09 |
| Cadmium | 0.4091042 | | | | | ND | | | |
| Lead | 44.89659863 | | | | | ND | | | |
| | | | | | SUMMARY CANCER RISK | | 3E-07 | 1E-06 | 1E-06 |

[1] MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
ND = no data available

MWSSIDAL
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SURFACE SOIL - ENTIRE SITE (EXLUDING SULFATE LANDFILL)
RECEPTOR: ON-SITE WORKER (PLANT B AREA AND MAINTENANCE ) - CURRENT LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-3

09-Jun-97

NONCARCINOGENIC EFFECTS

| COMPOUND | SOIL CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|
| 1,1,1-Trichloroethane | 0.006324323 | 1.00 | 2.2E-10 | 0.10 | 1.2E-09 | 9.0E-01 | 2.5E-10 | 1.3E-09 | 1.6E-09 |
| 1,1-Dichloroethene | 0.0009804 | 1.00 | 3.5E-11 | 0.10 | 1.8E-10 | 9.0E-03 | 3.8E-09 | 2.0E-08 | 2.4E-08 |
| 2,4,4-Trimethyl-1-pentene | 0.00053105 | 0.99 | 1.9E-11 | 0.11 | 1.1E-10 | 2.1E-01 | 9.0E-11 | 5.3E-10 | 6.2E-10 |
| 2-Butanone (MEK) | 0.000517312 | 1.00 | 1.8E-11 | 0.10 | 9.7E-11 | 6.0E-01 | 3.0E-11 | 1.6E-10 | 1.9E-10 |
| Acetone | 0.007891954 | 1.00 | 2.8E-10 | 0.10 | 1.5E-09 | 1.0E-01 | 2.8E-09 | 1.5E-08 | 1.8E-08 |
| Methylene Chloride | 0.002680076 | 1.00 | 9.4E-11 | 0.10 | 5.0E-10 | 6.0E-02 | 1.6E-09 | 8.3E-09 | 9.9E-09 |
| Tetrachloroethene (PCE) | 0.00187224 | 1.00 | 6.6E-11 | 0.10 | 3.5E-10 | 1.0E-02 | 6.6E-09 | 3.5E-08 | 4.2E-08 |
| Toluene | 0.003269972 | 1.00 | 1.2E-10 | 0.12 | 7.3E-10 | 2.0E-01 | 5.8E-10 | 3.7E-09 | 4.2E-09 |
| 2-Methylnaphthalene | 3.38426955 | 1.00 | 1.2E-07 | 0.20 | 1.3E-06 | 3.0E-02 | 4.0E-06 | 4.2E-05 | 4.6E-05 |
| 2-Methylphenol (o-Cresol) | 0.0060515 | 1.00 | 2.1E-10 | 0.19 | 2.1E-09 | 5.0E-02 | 4.3E-09 | 4.2E-08 | 4.7E-08 |
| Acenaphthene | 1.04778635 | 1.00 | 3.7E-08 | 0.20 | 3.9E-07 | 6.0E-02 | 6.2E-07 | 6.5E-06 | 7.1E-06 |
| Acenaphthylene | 2.559277806 | 0.91 | 8.2E-08 | 0.18 | 8.6E-07 | 3.0E-02 | 2.7E-06 | 2.9E-05 | 3.1E-05 |
| Anthracene | 1.785742086 | 1.00 | 6.3E-08 | 0.29 | 9.7E-07 | 3.0E-01 | 2.1E-07 | 3.2E-06 | 3.4E-06 |
| Benzo(a)Anthracene | 0.97406979 | 0.91 | 3.1E-08 | 0.18 | 3.3E-07 | 3.0E-02 | 1.0E-06 | 1.1E-05 | 1.2E-05 |
| Benzo(a)Pyrene | 0.71003095 | 0.91 | 2.3E-08 | 0.18 | 2.4E-07 | 3.0E-02 | 7.6E-07 | 8.0E-06 | 8.7E-06 |
| Benzo(b)Fluoranthene | 0.456302246 | 0.91 | 1.5E-08 | 0.18 | 1.5E-07 | 3.0E-02 | 4.9E-07 | 5.1E-06 | 5.6E-06 |
| Benzo(g,h,i)Perylene | 0.28812645 | 0.91 | 9.2E-09 | 0.18 | 9.7E-08 | 3.0E-02 | 3.1E-07 | 3.2E-06 | 3.5E-06 |
| Benzo(k)Fluoranthene | 0.5212271 | 0.91 | 1.7E-08 | 0.18 | 1.8E-07 | 3.0E-02 | 5.6E-07 | 5.8E-06 | 6.4E-06 |
| Benzoic Acid | 0.404715488 | 0.96 | 1.4E-08 | 0.18 | 1.4E-07 | 4.0E+00 | 3.4E-09 | 3.4E-08 | 3.7E-08 |
| Butylbenzylphthalate | 0.193246212 | 0.96 | 6.5E-09 | 0.18 | 6.5E-08 | 2.0E-01 | 3.3E-08 | 3.2E-07 | 3.6E-07 |
| Chrysene | 1.095360584 | 0.91 | 3.5E-08 | 0.18 | 3.7E-07 | 3.0E-02 | 1.2E-06 | 1.2E-05 | 1.3E-05 |
| Di-n-butylphthalate | 0.279702126 | 0.96 | 9.4E-09 | 0.18 | 9.4E-08 | 1.0E-01 | 9.4E-08 | 9.4E-07 | 1.0E-06 |
| Di-n-octylphthalate | 0.082199416 | 0.96 | 2.8E-09 | 0.18 | 2.7E-08 | 2.0E-02 | 1.4E-07 | 1.4E-06 | 1.5E-06 |
| Dibenzofuran | 0.277474248 | 1.00 | 9.8E-09 | 0.19 | 9.7E-08 | 3.0E-02 | 3.3E-07 | 3.2E-06 | 3.6E-06 |
| Diethylphthalate | 0.038086766 | 1.00 | 1.3E-09 | 0.02 | 1.4E-09 | 8.0E-01 | 1.7E-09 | 1.8E-09 | 3.5E-09 |
| Fluoranthene | 2.677110124 | 1.00 | 9.4E-08 | 0.20 | 1.0E-06 | 4.0E-02 | 2.4E-06 | 2.5E-05 | 2.7E-05 |
| Fluorene | 2.57569671 | 1.00 | 9.1E-08 | 0.20 | 9.6E-07 | 4.0E-02 | 2.3E-06 | 2.4E-05 | 2.6E-05 |
| Indeno (1,2,3-cd)Pyrene | 0.25962265 | 0.91 | 8.3E-09 | 0.18 | 8.7E-08 | 3.0E-02 | 2.8E-07 | 2.9E-06 | 3.2E-06 |
| N-Nitrosodiphenylamine | 1.051156552 | 0.96 | 3.5E-08 | 0.18 | 3.5E-07 | 5.0E-02 | 7.1E-07 | 7.0E-06 | 7.7E-06 |
| Naphthalene | 3.356851364 | 1.00 | 1.2E-07 | 0.10 | 6.3E-07 | 4.0E-02 | 3.0E-06 | 1.6E-05 | 1.9E-05 |
| Phenanthrene | 6.362283244 | 0.91 | 2.0E-07 | 0.18 | 2.1E-06 | 3.0E-02 | 6.8E-06 | 7.1E-05 | 7.8E-05 |
| Phenol | 0.337041 | 1.00 | 1.2E-08 | 0.26 | 1.6E-07 | 6.0E-01 | 2.0E-08 | 2.7E-07 | 2.9E-07 |

MWSSIDAL
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SURFACE SOIL - ENTIRE SITE (EXLUDING SULFATE LANDFILL)
RECEPTOR: ON-SITE WORKER (PLANT B AREA AND MAINTENANCE) - CURRENT LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-3

09-Jun-97

NONCARCINOGENIC EFFECTS

| COMPOUND | SOIL CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|
| Pyrene | 2.174239158 | 1.00 | 7.7E-08 | 0.20 | 8.1E-07 | 3.0E-02 | 2.6E-06 | 2.7E-05 | 3.0E-05 |
| bis(2-Ethyl(Hexyl)phthalate | 37.72849104 | 1.00 | 1.3E-06 | 0.02 | 1.4E-06 | 2.0E-02 | 6.6E-05 | 7.0E-05 | 1.4E-04 |
| 4,4'-DDD | 0.013510286 | 0.96 | 4.6E-10 | 0.18 | 4.5E-09 | 5.0E-04 | 9.1E-07 | 9.0E-06 | 9.9E-06 |
| 4,4'-DDE | 0.01495768 | 0.96 | 5.0E-10 | 0.18 | 5.0E-09 | 5.0E-04 | 1.0E-06 | 1.0E-05 | 1.1E-05 |
| 4,4'-DDT | 0.096925784 | 0.96 | 3.3E-09 | 0.18 | 3.2E-08 | 5.0E-04 | 6.5E-06 | 6.5E-05 | 7.1E-05 |
| Aldrin | 0.00081635 | 1.00 | 2.9E-11 | 0.25 | 3.8E-10 | 3.0E-05 | 9.6E-07 | 1.3E-05 | 1.4E-05 |
| Alpha-BHC | 0.001541392 | 0.96 | 5.2E-11 | 0.18 | 5.2E-10 | 5.0E-04 | 1.0E-07 | 1.0E-06 | 1.1E-06 |
| Alpha-Chlordane | 0.001231571 | 1.00 | 4.3E-11 | 0.05 | 1.2E-10 | 6.0E-05 | 7.2E-07 | 1.9E-06 | 2.6E-06 |
| Dieldrin | 0.000780928 | 1.00 | 2.8E-11 | 0.25 | 3.6E-10 | 5.0E-05 | 5.5E-07 | 7.3E-06 | 7.8E-06 |
| Endosulfan I | 0.001311112 | 0.96 | 4.4E-11 | 0.18 | 4.4E-10 | 6.0E-03 | 7.4E-09 | 7.3E-08 | 8.0E-08 |
| Endosulfan II | 0.00353234 | 0.96 | 1.2E-10 | 0.18 | 1.2E-09 | 6.0E-03 | 2.0E-08 | 2.0E-07 | 2.2E-07 |
| Endrin | 0.001643931 | 1.00 | 5.8E-11 | 0.25 | 7.7E-10 | 3.0E-04 | 1.9E-07 | 2.6E-06 | 2.8E-06 |
| Endrin Ketone | 0.000729454 | 0.96 | 2.5E-11 | 0.18 | 2.4E-10 | 3.0E-04 | 8.2E-08 | 8.1E-07 | 8.9E-07 |
| Gamma-BHC (Lindane) | 0.007240963 | 1.00 | 2.6E-10 | 0.20 | 2.7E-09 | 3.0E-04 | 8.5E-07 | 9.0E-06 | 9.9E-06 |
| Gamma-Chlordane | 0.001274346 | 1.00 | 4.5E-11 | 0.05 | 1.2E-10 | 6.0E-05 | 7.5E-07 | 2.0E-06 | 2.7E-06 |
| Heptachlor | 0.000056654 | 1.00 | 2.0E-12 | 0.20 | 2.1E-11 | 5.0E-04 | 4.0E-09 | 4.2E-08 | 4.6E-08 |
| Heptachlor Epoxide | 0.0001206 | 1.00 | 4.2E-12 | 0.20 | 4.5E-11 | 1.3E-05 | 3.3E-07 | 3.5E-06 | 3.8E-06 |
| PCB-1016 | 0.0156408 | 0.96 | 5.3E-10 | 0.18 | 5.2E-09 | 7.0E-05 | 7.5E-06 | 7.5E-05 | 8.2E-05 |
| Aluminum | 5693.433555 | | | | | | | | |
| Antimony | 1.696626612 | 1.00 | 6.0E-08 | 0.10 | 3.2E-07 | 4.0E-04 | 1.5E-04 | 7.9E-04 | 9.4E-04 |
| Arsenic | 9.554368578 | 1.00 | 3.4E-07 | 0.03 | 5.4E-07 | 3.0E-04 | 1.1E-03 | 1.8E-03 | 2.9E-03 |
| Barium | 21.64126823 | 0.71 | 5.4E-07 | 0.05 | 2.2E-06 | 7.0E-02 | 7.7E-06 | 3.2E-05 | 3.9E-05 |
| Beryllium | 0.037884618 | 1.00 | 1.3E-09 | 0.03 | 2.1E-09 | 5.0E-03 | 2.7E-07 | 4.2E-07 | 6.9E-07 |
| Cadmium | 0.4091042 | 1.00 | 1.4E-08 | 0.14 | 1.1E-07 | 5.0E-04 | 2.9E-05 | 2.1E-04 | 2.4E-04 |
| Calcium | 2380.75896 | | | | | | | | |
| Chromium III | 146.25945 | 1.00 | 5.2E-06 | 0.04 | 1.1E-05 | 1.0E+00 | 5.2E-06 | 1.1E-05 | 1.6E-05 |
| Chromium VI | 16.25105122 | 1.00 | 5.7E-07 | 0.09 | 2.7E-06 | 5.0E-03 | 1.1E-04 | 5.5E-04 | 6.6E-04 |
| Cobalt | 3.020114384 | 1.86 | 2.0E-07 | 0.14 | 8.1E-07 | 1.8E-01 | 1.1E-06 | 4.5E-06 | 5.6E-06 |
| Cyanide | 0.202692 | 1.00 | 7.1E-09 | 0.30 | 1.1E-07 | 2.0E-02 | 3.6E-07 | 5.7E-06 | 6.0E-06 |
| Iron | 8533.955256 | | | | | | | | |
| Lead | 44.89659863 | 0.50 | 7.9E-07 | 0.01 | 5.0E-07 | 7.5E-04 | 1.1E-03 | 6.7E-04 | 1.7E-03 |
| Manganese | 86.62145349 | 1.86 | 5.7E-06 | 0.14 | 2.3E-05 | 4.7E-02 | 1.2E-04 | 4.9E-04 | 6.1E-04 |
| Mercury | 0.128231552 | 1.00 | 4.5E-09 | 0.05 | 1.2E-08 | 3.0E-04 | 1.5E-05 | 4.0E-05 | 5.5E-05 |
| Nickel | 8.0484322 | 1.00 | 2.8E-07 | 0.35 | 5.3E-06 | 2.0E-02 | 1.4E-05 | 2.6E-04 | 2.8E-04 |
| Selenium | 0.633355458 | 1.00 | 2.2E-08 | 0.00 | 2.4E-09 | 5.0E-03 | 4.5E-06 | 4.7E-07 | 4.9E-06 |
| Sodium | 67.04148273 | | | | | | | | |
| Thallium | 0.546068228 | 1.00 | 1.9E-08 | 0.01 | 1.0E-08 | 8.0E-05 | 2.4E-04 | 1.3E-04 | 3.7E-04 |
| Vanadium | 17.53779468 | 0.71 | 4.4E-07 | 0.05 | 1.8E-06 | 7.0E-03 | 6.3E-05 | 2.6E-04 | 3.2E-04 |
| Zinc | 43.38254963 | 1.00 | 1.5E-06 | 0.02 | 1.6E-06 | 3.0E-01 | 5.1E-06 | 5.4E-06 | 1.0E-05 |
| Chloride | 54.3014319 | | | | | | | | |
| Nitrogen, Ammonia | 78.05334668 | 0.71 | 1.9E-06 | 0.05 | 8.0E-06 | 3.7E-01 | 5.3E-06 | 2.1E-05 | 2.7E-05 |
| Sulfate as SO4 | 1898.499298 | | | | | | | | |
| | | | | | | SUMMARY HAZARD INDEX | 3E-03 | 6E-03 | 9E-03 |

MWSSINAL
INHALATION EXPOSURE TO OHM IN SURFACE SOIL PARTICULATES - ENTIRE SITE (EXCLUDING SULFATE LANDFILL)
RECEPTOR: ON-SITE WORKER (PLANT B AREA AND MAINTENANCE) - CURRENT LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-4

09-Jun-97

EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| CONCENTRATION IN AIR | [RP]air | 32 | ug/m3 | MADEP, 1995 |
| CONCENTRATION IN SOIL | [OHM]part | chemical-specific | mg/kg | |
| CONVERSION FACTOR 1 | CF1 | 24 | hours/day | |
| EXPOSURE TIME DAILY (1) | ET | 2 | hours/day | Assumption |
| EXPOSURE FREQUENCY (2) | EF | 18 | days/year | Assumption |
| EXPOSURE DURATION | ED | 25 | years | USEPA, 1991 |
| CONVERSION FACTOR 2 | CF2 | 365 | days/year | |
| CONVERSION FACTOR 3 | CF3 | 0.000001 | kg/mg | |
| AVERAGING TIME CANCER | AT | 75 | years | MADEP, 1995 |
| AVERAGING TIME NONCANCER | AT | 25 | years | USEPA, 1991 |

(1) 12 hours per event, with each event occurring over a 6 day period (=12 hours per event/6 days per event=2 hours per day). Based on interview (9/24/96).
(2) 3 events per year, with each event occurring over a 6 day period (= 18 days per year). Based on interview (9/24/96).
MADEP, 1995. Guidance for Disposal Site Risk Characterization, Interim Final Policy WSC/ORS-95-141. July.
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors." OSWER Directive 9285.6-03.

EQUATIONS

CANCER RISK = AVG. CONC. (ug/m3) * CANCER UNIT RISK (ug/m3)^-1

HAZARD QUOTIENT = AVG.CONC.(ug/m3)/REF. CONC. (ug/m3)

$$\text{AVG. EXPOSURE CONC.} = \frac{[OHM]air * EF * ET * ED}{AT * CF1 * CF2}$$

OHM AIR CONC. = [RP]air * [OHM]part * CF3

Note:
*For noncarcinogenic effects: AT = ED

MWSSINAL
INHALATION EXPOSURE TO OHM IN SURFACE SOIL PARTICULATES - ENTIRE SITE (EXCLUDING SULFATE LANDFILL)
RECEPTOR: ON-SITE WORKER (PLANT B AREA AND MAINTENANCE ) - CURRENT LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-4

09-Jun-97

CARCINOGENIC EFFECTS

| COMPOUND | OHM SOIL CONCENTRATION (mg/kg) | OHM AIR CONCENTRATION (ug/m3) | AVERAGE AIR CONCENTRATION LIFETIME (ug/m3) | INHALATION CANCER UNIT RISK (ug/m3)^-1 | CANCER RISK |
|---|---|---|---|---|---|
| 1,1-Dichloroethene | 0.0009804 | 3.13728E-08 | 4.3E-11 | 5.0E-05 | 2.1E-15 |
| Methylene Chloride | 0.002680076 | 8.57624E-08 | 1.2E-10 | 4.7E-07 | 5.5E-17 |
| Tetrachloroethene (PCE) | 0.00187224 | 5.99117E-08 | 8.2E-11 | 5.9E-06 | 4.8E-16 |
| 2-Methylphenol (o-Cresol) | 0.0060515 | 1.93648E-07 | 2.7E-10 | ND | |
| Benzo(a)Anthracene | 0.97406979 | 3.11702E-05 | 4.3E-08 | 1.1E-04 | 4.7E-12 |
| Benzo(a)Pyrene | 0.71003095 | 2.2721E-05 | 3.1E-08 | 1.1E-03 | 3.4E-11 |
| Benzo(b)Fluoranthene | 0.456302246 | 1.46017E-05 | 2.0E-08 | 1.1E-04 | 2.2E-12 |
| Benzo(k)Fluoranthene | 0.5212271 | 1.66793E-05 | 2.3E-08 | 1.1E-05 | 2.5E-13 |
| Butylbenzylphthalate | 0.193246212 | 6.18388E-06 | 8.5E-09 | ND | |
| Chrysene | 1.095360584 | 3.50515E-05 | 4.8E-08 | 1.1E-06 | 5.3E-14 |
| Indeno (1,2,3-cd)Pyrene | 0.25962265 | 8.30792E-06 | 1.1E-08 | 1.1E-04 | 1.3E-12 |
| N-Nitrosodiphenylamine | 1.051156552 | 3.3637E-05 | 4.6E-08 | 2.6E-06 | 1.2E-13 |
| bis(2-EthylHexyl)phthalate | 37.72849104 | 0.001207312 | 1.7E-06 | 2.4E-06 | 4.0E-12 |
| 4,4'-DDD | 0.013510286 | 4.32329E-07 | 5.9E-10 | 9.7E-05 | 5.7E-14 |
| 4,4'-DDE | 0.01495768 | 4.78646E-07 | 6.6E-10 | 9.7E-05 | 6.4E-14 |
| 4,4'-DDT | 0.096925784 | 3.10163E-06 | 4.2E-09 | 9.7E-05 | 4.1E-13 |
| Aldrin | 0.00081635 | 2.61232E-08 | 3.6E-11 | 4.9E-03 | 1.8E-13 |
| Alpha-BHC | 0.001541392 | 4.93245E-08 | 6.8E-11 | 1.8E-03 | 1.2E-13 |
| Alpha-Chlordane | 0.001231571 | 3.94103E-08 | 5.4E-11 | 3.7E-04 | 2.0E-14 |
| Dieldrin | 0.000780928 | 2.49897E-08 | 3.4E-11 | 4.6E-03 | 1.6E-13 |
| Gamma-BHC (Lindane) | 0.007240963 | 2.31711E-07 | 3.2E-10 | 1.8E-05 | 5.8E-15 |
| Gamma-Chlordane | 0.001274346 | 4.07791E-08 | 5.6E-11 | 3.7E-04 | 2.1E-14 |
| Heptachlor | 0.000056654 | 1.81293E-09 | 2.5E-12 | 1.3E-03 | 3.2E-15 |
| Heptachlor Epoxide | 0.0001206 | 3.8592E-09 | 5.3E-12 | 2.6E-03 | 1.4E-14 |
| PCB-1016 | 0.0156408 | 5.00506E-07 | 6.9E-10 | ND | |
| Arsenic | 9.554368578 | 0.00030574 | 4.2E-07 | 4.3E-03 | 1.8E-09 |
| Beryllium | 0.037884618 | 1.21231E-06 | 1.7E-09 | 2.4E-03 | 4.0E-12 |
| Cadmium | 0.4091042 | 1.30913E-05 | 1.8E-08 | 1.8E-03 | 3.2E-11 |
| Chromium VI | 16.25105122 | 0.000520034 | 7.1E-07 | 1.2E-02 | 8.5E-09 |
| Lead | 44.89659863 | 0.001436691 | 2.0E-06 | ND | |
| Nickel | 8.0484322 | 0.00025755 | 3.5E-07 | 2.4E-04 | 8.5E-11 |
| | | | SUMMARY CANCER RISK | | 1E-08 |

ND = No data available.

MWSSINAL
INHALATION EXPOSURE TO OHM IN SURFACE SOIL PARTICULATES - ENTIRE SITE (EXCLUDING SULFATE LANDFILL)
RECEPTOR: ON-SITE WORKER (PLANT B AREA AND MAINTENANCE ) - CURRENT LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-4

09-Jun-97

NONCARCINOGENIC EFFECTS

| COMPOUND | OHM SOIL CONCENTRATION mg/kg | OHM AIR CONCENTRATION (ug/m3) | AVERAGE AIR CONCENTRATION FOR TIME PERIOD (ug/m3) | CHRONIC INHALATION RfC [1] (ug/m3) | HAZARD QUOTIENT |
|---|---|---|---|---|---|
| 1,1,1-Trichloroethane | 0.006324323 | 2.02378E-07 | 8.3E-10 | 1000 | 8.3E-13 |
| 1,1-Dichloroethene | 0.0009804 | 3.13728E-08 | 1.3E-10 | 50 | 2.6E-12 |
| 2,4,4-Trimethyl-1-pentene | 0.00053105 | 1.69936E-08 | 7.0E-11 | 717.5 | 9.7E-14 |
| 2-Butanone (MEK) | 0.000517312 | 1.6554E-08 | 6.8E-11 | 1000 | 6.8E-14 |
| Acetone | 0.007891954 | 2.52543E-07 | 1.0E-09 | 800 | 1.3E-12 |
| Methylene Chloride | 0.002680076 | 8.57624E-08 | 3.5E-10 | 3000 | 1.2E-13 |
| Tetrachloroethene (PCE) | 0.00187224 | 5.99117E-08 | 2.5E-10 | 4600 | 5.4E-14 |
| Toluene | 0.003269972 | 1.04639E-07 | 4.3E-10 | 400 | 1.1E-12 |
| 2-Methylnaphthalene | 3.38426955 | 0.000108297 | 4.5E-07 | 71 | 6.3E-09 |
| 2-Methylphenol (o-Cresol) | 0.0060515 | 1.93648E-07 | 8.0E-10 | 100 | 8.0E-12 |
| Acenaphthene | 1.04778635 | 3.35292E-05 | 1.4E-07 | 71 | 1.9E-09 |
| Acenaphthylene | 2.559277806 | 8.18969E-05 | 3.4E-07 | 71 | 4.7E-09 |
| Anthracene | 1.785742086 | 5.71437E-05 | 2.3E-07 | 71 | 3.3E-09 |
| Benzo(a)Anthracene | 0.97406979 | 3.11702E-05 | 1.3E-07 | 71 | 1.8E-09 |
| Benzo(a)Pyrene | 0.71003095 | 2.2721E-05 | 9.3E-08 | 71 | 1.3E-09 |
| Benzo(b)Fluoranthene | 0.456302246 | 1.46017E-05 | 6.0E-08 | 71 | 8.5E-10 |
| Benzo(g,h,i)Perylene | 0.28812645 | 9.22005E-06 | 3.8E-08 | 71 | 5.3E-10 |
| Benzo(k)Fluoranthene | 0.5212271 | 1.66793E-05 | 6.9E-08 | 71 | 9.7E-10 |
| Benzoic Acid | 0.404715488 | 1.29509E-05 | 5.3E-08 | | |
| Butylbenzylphthalate | 0.193246212 | 6.18388E-06 | 2.5E-08 | 7 | 3.6E-09 |
| Chrysene | 1.095360584 | 3.50515E-05 | 1.4E-07 | 71 | 2.0E-09 |
| Di-n-butylphthalate | 0.279702126 | 8.95047E-06 | 3.7E-08 | 7 | 5.3E-09 |
| Di-n-octylphthalate | 0.082199416 | 2.63038E-06 | 1.1E-08 | 7 | 1.5E-09 |
| Dibenzofuran | 0.277474248 | 8.87918E-06 | 3.6E-08 | | |
| Diethylphthalate | 0.038086766 | 1.21878E-06 | 5.0E-09 | 7 | 7.2E-10 |
| Fluoranthene | 2.677110124 | 8.56675E-05 | 3.5E-07 | 71 | 5.0E-09 |
| Fluorene | 2.57569671 | 8.24223E-05 | 3.4E-07 | 71 | 4.8E-09 |
| Indeno (1,2,3-cd)Pyrene | 0.25962265 | 8.30792E-06 | 3.4E-08 | 71 | 4.8E-10 |
| N-Nitrosodiphenylamine | 1.051156552 | 3.3637E-05 | 1.4E-07 | | |
| Naphthalene | 3.356851364 | 0.000107419 | 4.4E-07 | 71 | 6.2E-09 |
| Phenanthrene | 6.362283244 | 0.000203593 | 8.4E-07 | 71 | 1.2E-08 |
| Phenol | 0.337041 | 1.07853E-05 | 4.4E-08 | 260 | 1.7E-10 |
| Pyrene | 2.174239158 | 6.95757E-05 | 2.9E-07 | 71 | 4.0E-09 |
| bis(2-EthylHexyl)phthalate | 37.72849104 | 0.001207312 | 5.0E-06 | 7 | 7.1E-07 |
| 4,4'-DDD | 0.013510286 | 4.32329E-07 | 1.8E-09 | | |
| 4,4'-DDE | 0.01495768 | 4.78646E-07 | 2.0E-09 | | |
| 4,4'-DDT | 0.096925784 | 3.10163E-06 | 1.3E-08 | | |

MWSSINAL
INHALATION EXPOSURE TO OHM IN SURFACE SOIL PARTICULATES - ENTIRE SITE (EXCLUDING SULFATE LANDFILL)
RECEPTOR: ON-SITE WORKER (PLANT B AREA AND MAINTENANCE ) - CURRENT LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-4

09-Jun-97

NONCARCINOGENIC EFFECTS

| COMPOUND | OHM SOIL CONCENTRATION mg/kg | OHM AIR CONCENTRATION (ug/m3) | AVERAGE AIR CONCENTRATION FOR TIME PERIOD (ug/m3) | CHRONIC INHALATION RfC [1] (ug/m3) | HAZARD QUOTIENT |
|---|---|---|---|---|---|
| Aldrin | 0.00081635 | 2.61232E-08 | 1.1E-10 | | |
| Alpha-BHC | 0.001541392 | 4.93245E-08 | 2.0E-10 | 0.7 | 2.9E-10 |
| Alpha-Chlordane | 0.001231571 | 3.94103E-08 | 1.6E-10 | 0.7 | 2.3E-10 |
| Dieldrin | 0.000780928 | 2.49897E-08 | 1.0E-10 | | |
| Endosulfan I | 0.001311112 | 4.19556E-08 | 1.7E-10 | | |
| Endosulfan II | 0.00353234 | 1.13035E-07 | 4.6E-10 | | |
| Endrin | 0.001643931 | 5.26058E-08 | 2.2E-10 | | |
| Endrin Ketone | 0.000729454 | 2.33425E-08 | 9.6E-11 | | |
| Gamma-BHC (Lindane) | 0.007240963 | 2.31711E-07 | 9.5E-10 | 0.7 | 1.4E-09 |
| Gamma-Chlordane | 0.001274346 | 4.07791E-08 | 1.7E-10 | 0.7 | 2.4E-10 |
| Heptachlor | 0.000056654 | 1.81293E-09 | 7.5E-12 | 0.7 | 1.1E-11 |
| Heptachlor Epoxide | 0.0001206 | 3.8592E-09 | 1.6E-11 | 0.7 | 2.3E-11 |
| PCB-1016 | 0.0156408 | 5.00506E-07 | 2.1E-09 | 0.02 | 1.0E-07 |
| Aluminum | 5693.433555 | 0.182189874 | 7.5E-04 | | |
| Antimony | 1.696626612 | 5.42921E-05 | 2.2E-07 | 10 | 2.2E-08 |
| Arsenic | 9.554368578 | 0.00030574 | 1.3E-06 | 0.0025 | 5.0E-04 |
| Barium | 21.64126823 | 0.000692521 | 2.8E-06 | 0.5 | 5.7E-06 |
| Beryllium | 0.037884618 | 1.21231E-06 | 5.0E-09 | 0.005 | 1.0E-06 |
| Cadmium | 0.4091042 | 1.30913E-05 | 5.4E-08 | 0.2 | 2.7E-07 |
| Calcium | 2380.75896 | 0.076184287 | 3.1E-04 | | |
| Chromium III | 146.25945 | 0.004680302 | 1.9E-05 | 6.8 | 2.8E-06 |
| Chromium VI | 16.25105122 | 0.000520034 | 2.1E-06 | 0.02 | 1.1E-04 |
| Cobalt | 3.020114384 | 9.66437E-05 | 4.0E-07 | | |
| Cyanide | 0.202692 | 6.48614E-06 | 2.7E-08 | 1 | 2.7E-08 |
| Iron | 8533.955256 | 0.273086568 | 1.1E-03 | | |
| Lead | 44.89659863 | 0.001436691 | 5.9E-06 | 0.7 | 8.4E-06 |
| Manganese | 86.62145349 | 0.002771887 | 1.1E-05 | 0.05 | 2.3E-04 |
| Mercury | 0.128231552 | 4.10341E-06 | 1.7E-08 | 0.3 | 5.6E-08 |
| Nickel | 8.0484322 | 0.00025755 | 1.1E-06 | 0.009 | 1.2E-04 |
| Selenium | 0.633355458 | 2.02674E-05 | 8.3E-08 | 2.7 | 3.1E-08 |
| Sodium | 67.04148273 | 0.002145327 | 8.8E-06 | | |
| Thallium | 0.546068228 | 1.74742E-05 | 7.2E-08 | | |
| Vanadium | 17.53779468 | 0.000561209 | 2.3E-06 | 1.4 | 1.6E-06 |
| Zinc | 43.38254963 | 0.001388242 | 5.7E-06 | | |
| Chloride | 54.3014319 | 0.001737646 | 7.1E-06 | | |
| Nitrogen, Ammonia | 78.05334668 | 0.002497707 | 1.0E-05 | 100 | 1.0E-07 |
| Sulfate as SO4 | 1898.499298 | 0.060751978 | 2.5E-04 | | |
| | | | SUMMARY HAZARD INDEX | | 1E-03 |

ND = No data available.

CTSSIDSL
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SURFACE SOIL - SULFATE LANDFILL
RECEPTOR: NEIGHBORHOOD RESIDENT (AGES 7 THROUGH 16) - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-5

22-May-97

EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| CONCENTRATION SOIL | $[OHM]_{soil}$ | chemical specific | chemical-specific | |
| INGESTION RATE | IR | 50 | mg-soil/day | MADEP, 1995 |
| ADHERENCE FACTOR | AF | 0.51 | mg-soil/cm²-skin | MADEP, 1995 |
| AVERAGE SURFACE AREA (1) | SA | 4,521 | cm²/day | calculated per MADEP, 1995 |
| RELATIVE ABSORPTION FACTOR-ORAL | RAF-O | chemical specific | unitless | MADEP, 1994, 1995 |
| RELATIVE ABSORPTION FACTOR -DERM | RAF-D | chemical specific | unitless | MADEP, 1994, 1995 |
| CONVERSION FACTOR | CF | 1.00E-06 | kg/mg | |
| BODY WEIGHT (2) | BW | 42 | kg | calculated per MADEP, 1995 |
| EXPOSURE PERIOD | EP | 10 | years | Assumption |
| EXPOSURE FREQUENCY (3) | EF | 12 | events/year | Assumption |
| EXPOSURE DURATION | ED | 1 | day/event | Assumption |
| AVERAGING PERIOD | | | | |
| CANCER | AP | 75 | years | MADEP, 1995 |
| NONCANCER | AP | 10 | years | Assumption |

(1) 50th percentile of surface areas for males: head, hands, forearms, lower legs.
(2) 50th percentile of body weights for males.
(3) 2 events per month, May through October.
MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
MADEP, 1995. Guidance for Disposal Site Risk Characterization. Interim Final Policy WSC/ORS-95-141. July 1995.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)^-1

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE-INGESTION} = \frac{[OHM]soil \times IR \times RAF\text{-}O \times CF \times EF \times ED \times EP}{BW \times AP \times 365\ days/yr}$$

$$\text{INTAKE-DERMAL} = \frac{[OHM]soil \times SA \times AF \times RAF\text{-}D \times EF \times ED \times EP \times CF}{BW \times AP \times 365\ days/yr}$$

CTSSIDSL
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SURFACE SOIL - SULFATE LANDFILL
RECEPTOR: NEIGHBORHOOD RESIDENT (AGES 7 THROUGH 16) - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-5

22-May-97

CARCINOGENIC EFFECTS

| | SOIL CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | CANCER SLOPE FACTOR (mg/kg-day)^-1 | CANCER RISK INGESTION | CANCER RISK DERMAL | TOTAL CANCER RISK |
|---|---|---|---|---|---|---|---|---|---|
| Benzo(a)Anthracene | 0.038 | 1.00 | 2.0E-10 | 0.20 | 1.8E-09 | 7.3E-01 | 1.4E-10 | 1.3E-09 | 1.5E-09 |
| Benzo(a)Pyrene | 0.046 | 1.00 | 2.4E-10 | 0.20 | 2.2E-09 | 7.3E+00 | 1.8E-09 | 1.6E-08 | 1.8E-08 |
| Benzo(b)Fluoranthene | 0.0665 | 1.00 | 3.5E-10 | 0.20 | 3.2E-09 | 7.3E-01 | 2.5E-10 | 2.3E-09 | 2.6E-09 |
| Benzo(k)Fluoranthene | 0.018 | 1.00 | 9.4E-11 | 0.20 | 8.7E-10 | 7.3E-02 | 6.9E-12 | 6.3E-11 | 7.0E-11 |
| Chrysene | 0.0445 | 1.00 | 2.3E-10 | 0.20 | 2.1E-09 | 7.3E-03 | 1.7E-12 | 1.6E-11 | 1.7E-11 |
| Indeno (1,2,3-cd)Pyrene | 0.047 | 1.00 | 2.5E-10 | 0.20 | 2.3E-09 | 7.3E-01 | 1.8E-10 | 1.7E-09 | 1.8E-09 |
| bis(2-EthylHexyl)phthalate | 0.083 | 1.00 | 4.3E-10 | 0.02 | 4.0E-10 | 1.4E-02 | 6.1E-12 | 5.6E-12 | 1.2E-11 |
| Arsenic | 8.0333 | 1.00 | 4.2E-08 | 0.03 | 5.8E-08 | 1.5E+00 | 6.3E-08 | 8.7E-08 | 1.5E-07 |
| Lead | 28.5 | | | | | ND | | | |
| | | | | | | SUMMARY CANCER RISK | 7E-08 | 1E-07 | 2E-07 |

[1] MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.

CTSSIDSL
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SURFACE SOIL - SULFATE LANDFILL
RECEPTOR: NEIGHBORHOOD RESIDENT (AGES 7 THROUGH 16) - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-5

22-May-97

NONCARCINOGENIC EFFECTS

| COMPOUND | SOIL CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|
| Toluene | 0.003 | 1.00 | 1.2E-10 | 0.12 | 6.5E-10 | 2.0E-01 | 5.9E-10 | 3.2E-09 | 3.8E-09 |
| Benzo(a)Anthracene | 0.038 | 0.91 | 1.4E-09 | 0.18 | 1.2E-08 | 3.0E-02 | 4.5E-08 | 4.1E-07 | 4.6E-07 |
| Benzo(a)Pyrene | 0.046 | 0.91 | 1.6E-09 | 0.18 | 1.5E-08 | 3.0E-02 | 5.5E-08 | 5.0E-07 | 5.5E-07 |
| Benzo(b)Fluoranthene | 0.0665 | 0.91 | 2.4E-09 | 0.18 | 2.2E-08 | 3.0E-02 | 7.9E-08 | 7.2E-07 | 8.0E-07 |
| Benzo(g,h,i)Perylene | 0.029 | 0.91 | 1.0E-09 | 0.18 | 9.4E-09 | 3.0E-02 | 3.4E-08 | 3.1E-07 | 3.5E-07 |
| Benzo(k)Fluoranthene | 0.018 | 0.91 | 6.4E-10 | 0.18 | 5.8E-09 | 3.0E-02 | 2.1E-08 | 1.9E-07 | 2.2E-07 |
| Chrysene | 0.0445 | 0.91 | 1.6E-09 | 0.18 | 1.4E-08 | 3.0E-02 | 5.3E-08 | 4.8E-07 | 5.3E-07 |
| Di-n-butylphthalate | 0.017 | 0.96 | 6.4E-10 | 0.18 | 5.5E-09 | 1.0E-01 | 6.4E-09 | 5.5E-08 | 6.1E-08 |
| Fluoranthene | 0.0825 | 1.00 | 3.2E-09 | 0.20 | 3.0E-08 | 4.0E-02 | 8.1E-08 | 7.4E-07 | 8.3E-07 |
| Indeno (1,2,3-cd)Pyrene | 0.047 | 0.91 | 1.7E-09 | 0.18 | 1.5E-08 | 3.0E-02 | 5.6E-08 | 5.1E-07 | 5.6E-07 |
| Phenanthrene | 0.042 | 0.91 | 1.5E-09 | 0.18 | 1.4E-08 | 3.0E-02 | 5.0E-08 | 4.5E-07 | 5.0E-07 |
| Pyrene | 0.063 | 1.00 | 2.5E-09 | 0.20 | 2.3E-08 | 3.0E-02 | 8.2E-08 | 7.6E-07 | 8.4E-07 |
| bis(2-EthylHexyl)phthalate | 0.083 | 1.00 | 3.2E-09 | 0.02 | 3.0E-09 | 2.0E-02 | 1.6E-07 | 1.5E-07 | 3.1E-07 |
| Aluminum | 4826.6667 | | | | | | | | |
| Arsenic | 8.0333 | 1.00 | 3.1E-07 | 0.03 | 4.3E-07 | 3.0E-04 | 1.0E-03 | 1.4E-03 | 2.5E-03 |
| Barium | 13.9167 | 0.71 | 3.9E-07 | 0.05 | 1.4E-06 | 7.0E-02 | 5.5E-06 | 2.0E-05 | 2.5E-05 |
| Calcium | 627.1833 | | | | | | | | |
| Chromium III | 15.75 | 1.00 | 6.2E-07 | 0.04 | 1.1E-06 | 1.0E+00 | 6.2E-07 | 1.1E-06 | 1.8E-06 |
| Chromium VI | 1.75 | 1.00 | 6.8E-08 | 0.09 | 2.8E-07 | 5.0E-03 | 1.4E-05 | 5.7E-05 | 7.1E-05 |
| Cobalt | 2.5417 | 1.86 | 1.8E-07 | 0.14 | 6.6E-07 | 6.0E-02 | 3.1E-06 | 1.1E-05 | 1.4E-05 |
| Iron | 6990 | | | | | | | | |
| Lead | 28.5 | 0.50 | 5.6E-07 | 0.01 | 3.1E-07 | 7.5E-04 | 7.4E-04 | 4.1E-04 | 1.2E-03 |
| Manganese | 109.15 | 1.86 | 7.9E-06 | 0.14 | 2.8E-05 | 4.7E-02 | 1.7E-04 | 6.0E-04 | 7.7E-04 |
| Nickel | 4.1 | 1.00 | 1.6E-07 | 0.35 | 2.6E-06 | 2.0E-02 | 8.0E-06 | 1.3E-04 | 1.4E-04 |
| Selenium | 0.5175 | 1.00 | 2.0E-08 | 0.00 | 1.9E-09 | 5.0E-03 | 4.1E-06 | 3.7E-07 | 4.4E-06 |

[1] MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
ND = no data available

CTSSIDSL
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SURFACE SOIL - SULFATE LANDFILL
RECEPTOR: NEIGHBORHOOD RESIDENT (AGES 7 THROUGH 16) - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-5

22-May-97
NONCARCINOGENIC EFFECTS (CONTINUED)

| | SOIL CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|
| Sodium | 37 | | | | | | | | |
| Thallium | 0.66 | 1.00 | 2.6E-08 | 0.01 | 1.2E-08 | 8.0E-05 | 3.2E-04 | 1.5E-04 | 4.7E-04 |
| Vanadium | 14.8333 | 0.71 | 4.1E-07 | 0.05 | 1.5E-06 | 7.0E-03 | 5.9E-05 | 2.1E-04 | 2.7E-04 |
| Zinc | 22.5167 | 1.00 | 8.8E-07 | 0.02 | 8.1E-07 | 3.0E-01 | 2.9E-06 | 2.7E-06 | 5.6E-06 |
| Chloride | 61.5 | | | | | | | | |
| Nitrogen, Ammonia | 17 | 0.71 | 4.7E-07 | 0.05 | 1.7E-06 | 3.7E-01 | 1.3E-06 | 4.5E-06 | 5.8E-06 |
| Sulfate as SO4 | 30.5 | | | | | | | | |
| SUMMARY HAZARD INDEX | | | | | | | 2E-03 | 3E-03 | 5E-03 |

[1] MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
ND = no data available

CTSSIDAL
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SURFACE SOIL - ENTIRE SITE (EXLUDING SULFATE LANDFILL)
RECEPTOR: NEIGHBORHOOD RESIDENT (AGES 7 THROUGH 16) - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-6

09-Jun-97

EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| CONCENTRATION SOIL | $[OHM]_{soil}$ | chemical specific | chemical-specific | |
| INGESTION RATE | IR | 50 | mg-soil/day | MADEP, 1995 |
| ADHERENCE FACTOR | AF | 0.51 | mg-soil/cm²-skin | MADEP, 1995 |
| AVERAGE SURFACE AREA (1) | SA | 4,521 | cm²/day | calculated per MADEP, 1995 |
| RELATIVE ABSORPTION FACTOR-ORAL | RAF-O | chemical specific | unitless | MADEP, 1994, 1995 |
| RELATIVE ABSORPTION FACTOR -DERM | RAF-D | chemical specific | unitless | MADEP, 1994, 1995 |
| CONVERSION FACTOR | CF | 1.00E-06 | kg/mg | |
| BODY WEIGHT (2) | BW | 42 | kg | calculated per MADEP, 1995 |
| EXPOSURE PERIOD | EP | 10 | years | Assumption |
| EXPOSURE FREQUENCY (3) | EF | 12 | events/year | Assumption |
| EXPOSURE DURATION | ED | 1 | day/event | Assumption |
| AVERAGING PERIOD | | | | |
| CANCER | AP | 75 | years | MADEP, 1995 |
| NONCANCER | AP | 10 | years | Assumption |

(1) 50th percentile of surface areas for males: head, hands, forearms, lower legs.
(2) 50th percentile of body weights for males.
(3) 2 events per month, May through October.
MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
MADEP, 1995. Guidance for Disposal Site Risk Characterization. Interim Final Policy WSC/ORS-95-141. July 1995.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)^-1

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE-INGESTION} = \frac{[OHM]soil \times IR \times RAF\text{-}O \times CF \times EF \times ED \times EP}{BW \times AP \times 365 \text{ days/yr}}$$

$$\text{INTAKE-DERMAL} = \frac{[OHM]soil \times SA \times AF \times RAF\text{-}D \times EF \times ED \times EP \times CF}{BW \times AP \times 365 \text{ days/yr}}$$

CTSSIDAL
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SURFACE SOIL - ENTIRE SITE (EXLUDING SULFATE LANDFILL)
RECEPTOR: NEIGHBORHOOD RESIDENT (AGES 7 THROUGH 16) - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-6

09-Jun-97

CARCINOGENIC EFFECTS

| | SOIL CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | CANCER SLOPE FACTOR (mg/kg-day)^-1 | CANCER RISK INGESTION | CANCER RISK DERMAL | TOTAL CANCER RISK |
|---|---|---|---|---|---|---|---|---|---|
| 1,1-Dichloroethene | 0.0009804 | 1.02 | 5.2E-12 | 0.10 | 2.4E-11 | 6.0E-01 | 3.1E-12 | 1.4E-11 | 1.8E-11 |
| Methylene Chloride | 0.002680076 | 1.00 | 1.4E-11 | 0.10 | 6.4E-11 | 7.5E-03 | 1.0E-13 | 4.8E-13 | 5.9E-13 |
| Tetrachloroethene (PCE) | 0.00187224 | 1.00 | 9.8E-12 | 0.10 | 4.5E-11 | 5.1E-02 | 5.0E-13 | 2.3E-12 | 2.8E-12 |
| 2-Methylphenol (o-Cresol) | 0.0060515 | | | | | ND | | | |
| Benzo(a)Anthracene | 0.97406979 | 1.00 | 5.1E-09 | 0.20 | 4.7E-08 | 7.3E-01 | 3.7E-09 | 3.4E-08 | 3.8E-08 |
| Benzo(a)Pyrene | 0.71003095 | 1.00 | 3.7E-09 | 0.20 | 3.4E-08 | 7.3E+00 | 2.7E-08 | 2.5E-07 | 2.8E-07 |
| Benzo(b)Fluoranthene | 0.456302246 | 1.00 | 2.4E-09 | 0.20 | 2.2E-08 | 7.3E-01 | 1.7E-09 | 1.6E-08 | 1.8E-08 |
| Benzo(k)Fluoranthene | 0.5212271 | 1.00 | 2.7E-09 | 0.20 | 2.5E-08 | 7.3E-02 | 2.0E-10 | 1.8E-09 | 2.0E-09 |
| Butylbenzylphthalate | 0.193246212 | | | | | ND | | | |
| Chrysene | 1.095360584 | 1.00 | 5.7E-09 | 0.20 | 5.3E-08 | 7.3E-03 | 4.2E-11 | 3.8E-10 | 4.3E-10 |
| Indeno (1,2,3-cd)Pyrene | 0.25962265 | 1.00 | 1.4E-09 | 0.20 | 1.2E-08 | 7.3E-01 | 9.9E-10 | 9.1E-09 | 1.0E-08 |
| N-Nitrosodiphenylamine | 1.051156552 | 0.91 | 5.0E-09 | 0.17 | 4.3E-08 | 4.9E-03 | 2.4E-11 | 2.1E-10 | 2.4E-10 |
| bis(2-EthylHexyl)phthalate | 37.72849104 | 1.00 | 2.0E-07 | 0.02 | 1.8E-07 | 1.4E-02 | 2.8E-09 | 2.5E-09 | 5.3E-09 |
| 4,4'-DDD | 0.013510286 | 1.00 | 7.1E-11 | 0.20 | 6.5E-10 | 2.4E-01 | 1.7E-11 | 1.6E-10 | 1.7E-10 |
| 4,4'-DDE | 0.01495768 | 1.00 | 7.8E-11 | 0.20 | 7.2E-10 | 3.4E-01 | 2.7E-11 | 2.4E-10 | 2.7E-10 |
| 4,4'-DDT | 0.096925784 | 1.00 | 5.1E-10 | 0.20 | 4.7E-09 | 3.4E-01 | 1.7E-10 | 1.6E-09 | 1.8E-09 |
| Aldrin | 0.00081635 | 1.00 | 4.3E-12 | 0.25 | 4.9E-11 | 1.7E+01 | 7.2E-11 | 8.3E-10 | 9.1E-10 |
| Alpha-BHC | 0.001541392 | 0.96 | 7.7E-12 | 0.18 | 6.6E-11 | 6.3E+00 | 4.9E-11 | 4.2E-10 | 4.7E-10 |
| Alpha-Chlordane | 0.001231571 | 1.00 | 6.4E-12 | 0.05 | 1.5E-11 | 1.3E+00 | 8.4E-12 | 1.9E-11 | 2.8E-11 |
| Dieldrin | 0.000780928 | 1.00 | 4.1E-12 | 0.25 | 4.7E-11 | 1.6E+01 | 6.5E-11 | 7.5E-10 | 8.2E-10 |
| Gamma-BHC (Lindane) | 0.007240963 | 1.00 | 3.8E-11 | 0.20 | 3.5E-10 | 1.3E+00 | 4.9E-11 | 4.5E-10 | 5.0E-10 |
| Gamma-Chlordane | 0.001274346 | 1.00 | 6.7E-12 | 0.05 | 1.5E-11 | 1.3E+00 | 8.6E-12 | 2.0E-11 | 2.9E-11 |
| Heptachlor | 0.000056654 | 1.00 | 3.0E-13 | 0.20 | 2.7E-12 | 4.5E+00 | 1.3E-12 | 1.2E-11 | 1.4E-11 |
| Heptachlor Epoxide | 0.0001206 | 1.00 | 6.3E-13 | 0.20 | 5.8E-12 | 9.1E+00 | 5.7E-12 | 5.3E-11 | 5.9E-11 |
| PCB-1016 | 0.0156408 | 0.85 | 6.9E-11 | 0.07 | 2.6E-10 | 2.0E+00 | 1.4E-10 | 5.3E-10 | 6.7E-10 |
| Arsenic | 9.554368578 | 1.00 | 5.0E-08 | 0.03 | 6.9E-08 | 1.5E+00 | 7.5E-08 | 1.0E-07 | 1.8E-07 |
| Beryllium | 0.037884618 | 1.00 | 2.0E-10 | 0.03 | 2.7E-10 | 4.3E+00 | 8.5E-10 | 1.2E-09 | 2.0E-09 |
| Cadmium | 0.4091042 | | | | | ND | | | |
| Lead | 44.89659863 | | | | | ND | | | |
| | | | | | SUMMARY CANCER RISK | | 1E-07 | 4E-07 | 5E-07 |

[1] MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
ND = no data available

CTSSIDAL
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SURFACE SOIL - ENTIRE SITE (EXLUDING SULFATE LANDFILL)
RECEPTOR: NEIGHBORHOOD RESIDENT (AGES 7 THROUGH 16) - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-6

09-Jun-97

NONCARCINOGENIC EFFECTS

| COMPOUND | SOIL CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|
| 1,1,1-Trichloroethene | 0.006324523 | 1.00 | 2.5E-10 | 0.10 | 1.1E-09 | 9.0E-01 | 2.8E-10 | 1.3E-09 | 1.5E-09 |
| 1,1-Dichloroethene | 0.0009804 | 1.00 | 3.8E-11 | 0.10 | 1.8E-10 | 9.0E-03 | 4.3E-09 | 2.0E-08 | 2.4E-08 |
| 2,4,4-Trimethyl-1-pentene | 0.00053105 | 0.99 | 2.1E-11 | 0.11 | 1.1E-10 | 2.1E-01 | 1.0E-10 | 5.1E-10 | 6.1E-10 |
| 2-Butanone (MEK) | 0.000517312 | 1.00 | 2.0E-11 | 0.10 | 9.3E-11 | 6.0E-01 | 3.4E-11 | 1.6E-10 | 1.9E-10 |
| Acetone | 0.007891954 | 1.00 | 3.1E-10 | 0.10 | 1.4E-09 | 1.0E-01 | 3.1E-09 | 1.4E-08 | 1.7E-08 |
| Methylene Chloride | 0.002680076 | 1.00 | 1.0E-10 | 0.10 | 4.8E-10 | 6.0E-02 | 1.7E-09 | 8.1E-09 | 9.8E-09 |
| Tetrachloroethene (PCE) | 0.00187224 | 1.00 | 7.3E-11 | 0.10 | 3.4E-10 | 1.0E-02 | 7.3E-09 | 3.4E-08 | 4.1E-08 |
| Toluene | 0.003269972 | 1.00 | 1.3E-10 | 0.12 | 7.1E-10 | 2.0E-01 | 6.4E-10 | 3.5E-09 | 4.2E-09 |
| 2-Methylnaphthalene | 3.38426955 | 1.00 | 1.3E-07 | 0.20 | 1.2E-06 | 3.0E-02 | 4.4E-06 | 4.1E-05 | 4.5E-05 |
| 2-Methylphenol (o-Cresol) | 0.0060515 | 1.00 | 2.4E-10 | 0.19 | 2.0E-09 | 5.0E-02 | 4.7E-09 | 4.1E-08 | 4.6E-08 |
| Acenaphthene | 1.04778635 | 1.00 | 4.1E-08 | 0.20 | 3.8E-07 | 6.0E-02 | 6.8E-07 | 6.3E-06 | 7.0E-06 |
| Acenaphthylene | 2.559277806 | 0.91 | 9.1E-08 | 0.18 | 8.3E-07 | 3.0E-02 | 3.0E-06 | 2.8E-05 | 3.1E-05 |
| Anthracene | 1.785742086 | 1.00 | 7.0E-08 | 0.29 | 9.3E-07 | 3.0E-01 | 2.3E-07 | 3.1E-06 | 3.3E-06 |
| Benzo(a)Anthracene | 0.97406979 | 0.91 | 3.5E-08 | 0.18 | 3.2E-07 | 3.0E-02 | 1.2E-06 | 1.1E-05 | 1.2E-05 |
| Benzo(a)Pyrene | 0.71003095 | 0.91 | 2.5E-08 | 0.18 | 2.3E-07 | 3.0E-02 | 8.4E-07 | 7.7E-06 | 8.5E-06 |
| Benzo(b)Fluoranthene | 0.456302246 | 0.91 | 1.6E-08 | 0.18 | 1.5E-07 | 3.0E-02 | 5.4E-07 | 4.9E-06 | 5.5E-06 |
| Benzo(g,h,i)Perylene | 0.28812645 | 0.91 | 1.0E-08 | 0.18 | 9.4E-08 | 3.0E-02 | 3.4E-07 | 3.1E-06 | 3.5E-06 |
| Benzo(k)Fluoranthene | 0.5212271 | 0.91 | 1.9E-08 | 0.18 | 1.7E-07 | 3.0E-02 | 6.2E-07 | 5.6E-06 | 6.3E-06 |
| Benzoic Acid | 0.404715488 | 0.96 | 1.5E-08 | 0.18 | 1.3E-07 | 4.0E+00 | 3.8E-09 | 3.3E-08 | 3.6E-08 |
| Butylbenzylphthalate | 0.193246212 | 0.96 | 7.2E-09 | 0.18 | 6.2E-08 | 2.0E-01 | 3.6E-08 | 3.1E-07 | 3.5E-07 |
| Chrysene | 1.095360584 | 0.91 | 3.9E-08 | 0.18 | 3.6E-07 | 3.0E-02 | 1.3E-06 | 1.2E-05 | 1.3E-05 |
| Di-n-butylphthalate | 0.279702126 | 0.96 | 1.0E-08 | 0.18 | 9.0E-08 | 1.0E-01 | 1.0E-07 | 9.0E-07 | 1.0E-06 |
| Di-n-octylphthalate | 0.082199416 | 0.96 | 3.1E-09 | 0.18 | 2.7E-08 | 2.0E-02 | 1.5E-07 | 1.3E-06 | 1.5E-06 |
| Dibenzofuran | 0.277474248 | 1.00 | 1.1E-08 | 0.19 | 9.4E-08 | 3.0E-02 | 3.6E-07 | 3.1E-06 | 3.5E-06 |
| Diethylphthalate | 0.038086766 | 1.00 | 1.5E-09 | 0.02 | 1.4E-09 | 8.0E-01 | 1.9E-09 | 1.7E-09 | 3.6E-09 |
| Fluoranthene | 2.677110124 | 1.00 | 1.0E-07 | 0.20 | 9.7E-07 | 4.0E-02 | 2.6E-06 | 2.4E-05 | 2.7E-05 |
| Fluorene | 2.57569671 | 1.00 | 1.0E-07 | 0.20 | 9.3E-07 | 4.0E-02 | 2.5E-06 | 2.3E-05 | 2.6E-05 |
| Indeno (1,2,3-cd)Pyrene | 0.25962265 | 0.91 | 9.2E-09 | 0.18 | 8.4E-08 | 3.0E-02 | 3.1E-07 | 2.8E-06 | 3.1E-06 |
| N-Nitrosodiphenylamine | 1.051156552 | 0.96 | 3.9E-08 | 0.18 | 3.4E-07 | 5.0E-02 | 7.9E-07 | 6.8E-06 | 7.6E-06 |
| Naphthalene | 3.356851364 | 1.00 | 1.3E-07 | 0.10 | 6.1E-07 | 4.0E-02 | 3.3E-06 | 1.5E-05 | 1.8E-05 |
| Phenanthrene | 6.362283244 | 0.91 | 2.3E-07 | 0.18 | 2.1E-06 | 3.0E-02 | 7.6E-06 | 6.9E-05 | 7.6E-05 |
| Phenol | 0.337041 | 1.00 | 1.3E-08 | 0.26 | 1.6E-07 | 6.0E-01 | 2.2E-08 | 2.6E-07 | 2.9E-07 |

CTSSIDAL
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SURFACE SOIL - ENTIRE SITE (EXLUDING SULFATE LANDFILL)
RECEPTOR: NEIGHBORHOOD RESIDENT (AGES 7 THROUGH 16) - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-6

09-Jun-97

NONCARCINOGENIC EFFECTS

| COMPOUND | SOIL CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|
| Pyrene | 2.174239158 | 1.00 | 8.5E-08 | 0.20 | 7.8E-07 | 3.0E-02 | 2.8E-06 | 2.6E-05 | 2.9E-05 |
| bis(2-EthylHexyl)phthalate | 37.72849104 | 1.00 | 1.5E-06 | 0.02 | 1.4E-06 | 2.0E-02 | 7.4E-05 | 6.8E-05 | 1.4E-04 |
| 4,4'-DDD | 0.013510286 | 0.96 | 5.1E-10 | 0.18 | 4.4E-09 | 5.0E-04 | 1.0E-06 | 8.7E-06 | 9.7E-06 |
| 4,4'-DDE | 0.01495768 | 0.96 | 5.6E-10 | 0.18 | 4.8E-09 | 5.0E-04 | 1.1E-06 | 9.7E-06 | 1.1E-05 |
| 4,4'-DDT | 0.096925784 | 0.96 | 3.6E-09 | 0.18 | 3.1E-08 | 5.0E-04 | 7.3E-06 | 6.3E-05 | 7.0E-05 |
| Aldrin | 0.00081635 | 1.00 | 3.2E-11 | 0.25 | 3.7E-10 | 3.0E-05 | 1.1E-06 | 1.2E-05 | 1.3E-05 |
| Alpha-BHC | 0.001541392 | 0.96 | 5.8E-11 | 0.18 | 5.0E-10 | 5.0E-04 | 1.2E-07 | 1.0E-06 | 1.1E-06 |
| Alpha-Chlordane | 0.001231571 | 1.00 | 4.8E-11 | 0.05 | 1.1E-10 | 6.0E-05 | 8.0E-07 | 1.9E-06 | 2.7E-06 |
| Dieldrin | 0.000780928 | 1.00 | 3.1E-11 | 0.25 | 3.5E-10 | 5.0E-05 | 6.1E-07 | 7.0E-06 | 7.7E-06 |
| Endosulfan I | 0.001311112 | 0.96 | 4.9E-11 | 0.18 | 4.2E-10 | 6.0E-03 | 8.2E-09 | 7.1E-08 | 7.9E-08 |
| Endosulfan II | 0.00353234 | 0.96 | 1.3E-10 | 0.18 | 1.1E-09 | 6.0E-03 | 2.2E-08 | 1.9E-07 | 2.1E-07 |
| Endrin | 0.001643931 | 1.00 | 6.4E-11 | 0.25 | 7.4E-10 | 3.0E-04 | 2.1E-07 | 2.5E-06 | 2.7E-06 |
| Endrin Ketone | 0.000729454 | 0.96 | 2.7E-11 | 0.18 | 2.4E-10 | 3.0E-04 | 9.1E-08 | 7.9E-07 | 8.8E-07 |
| Gamma-BHC (Lindane) | 0.007240963 | 1.00 | 2.8E-10 | 0.20 | 2.6E-09 | 3.0E-04 | 9.4E-07 | 8.7E-06 | 9.7E-06 |
| Gamma-Chlordane | 0.001274346 | 1.00 | 5.0E-11 | 0.05 | 1.2E-10 | 6.0E-05 | 8.3E-07 | 1.9E-06 | 2.7E-06 |
| Heptachlor | 0.000056654 | 1.00 | 2.2E-12 | 0.20 | 2.0E-11 | 5.0E-04 | 4.4E-09 | 4.1E-08 | 4.5E-08 |
| Heptachlor Epoxide | 0.0001206 | 1.00 | 4.7E-12 | 0.20 | 4.4E-11 | 1.3E-05 | 3.6E-07 | 3.3E-06 | 3.7E-06 |
| PCB-1016 | 0.0156408 | 0.96 | 5.9E-10 | 0.18 | 5.1E-09 | 7.0E-05 | 8.4E-06 | 7.2E-05 | 8.1E-05 |
| Aluminum | 5693.433555 | | | | | | | | |
| Antimony | 1.696626612 | 1.00 | 6.6E-08 | 0.10 | 3.1E-07 | 4.0E-04 | 1.7E-04 | 7.7E-04 | 9.3E-04 |
| Arsenic | 9.554368578 | 1.00 | 3.7E-07 | 0.03 | 5.2E-07 | 3.0E-04 | 1.2E-03 | 1.7E-03 | 3.0E-03 |
| Barium | 21.64126823 | 0.71 | 6.0E-07 | 0.05 | 2.1E-06 | 7.0E-02 | 8.6E-06 | 3.0E-05 | 3.9E-05 |
| Beryllium | 0.037884618 | 1.00 | 1.5E-09 | 0.03 | 2.1E-09 | 5.0E-03 | 3.0E-07 | 4.1E-07 | 7.1E-07 |
| Cadmium | 0.4091042 | 1.00 | 1.6E-08 | 0.14 | 1.0E-07 | 5.0E-04 | 3.2E-05 | 2.1E-04 | 2.4E-04 |
| Calcium | 2380.75896 | | | | | | | | |
| Chromium III | 146.259461 | 1.00 | 5.7E-06 | 0.04 | 1.1E-05 | 1.0E+00 | 5.7E-06 | 1.1E-05 | 1.6E-05 |
| Chromium VI | 16.25105122 | 1.00 | 6.4E-07 | 0.09 | 2.6E-06 | 5.0E-03 | 1.3E-04 | 5.3E-04 | 6.6E-04 |
| Cobalt | 3.020114384 | 1.86 | 2.2E-07 | 0.14 | 7.8E-07 | 6.0E-02 | 3.7E-06 | 1.3E-05 | 1.7E-05 |
| Cyanide | 0.202692 | 1.00 | 7.9E-09 | 0.30 | 1.1E-07 | 2.0E-02 | 4.0E-07 | 5.5E-06 | 5.9E-06 |
| Iron | 8533.955256 | | | | | | | | |
| Lead | 44.89659863 | 0.50 | 8.8E-07 | 0.01 | 4.9E-07 | 7.5E-04 | 1.2E-03 | 6.5E-04 | 1.8E-03 |
| Manganese | 86.62145349 | 1.86 | 6.3E-06 | 0.14 | 2.2E-05 | 4.7E-02 | 1.3E-04 | 4.8E-04 | 6.1E-04 |
| Mercury | 0.128231552 | 1.00 | 5.0E-09 | 0.05 | 1.2E-08 | 3.0E-04 | 1.7E-05 | 3.9E-05 | 5.5E-05 |
| Nickel | 8.0484322 | 1.00 | 3.2E-07 | 0.35 | 5.1E-06 | 2.0E-02 | 1.6E-05 | 2.5E-04 | 2.7E-04 |
| Selenium | 0.633355458 | 1.00 | 2.5E-08 | 0.00 | 2.3E-09 | 5.0E-03 | 5.0E-06 | 4.6E-07 | 5.4E-06 |
| Sodium | 67.04148273 | | | | | | | | |
| Thallium | 0.546068228 | 1.00 | 2.1E-08 | 0.01 | 9.9E-09 | 8.0E-05 | 2.7E-04 | 1.2E-04 | 3.9E-04 |
| Vanadium | 17.53779468 | 0.71 | 4.9E-07 | 0.05 | 1.7E-06 | 7.0E-03 | 7.0E-05 | 2.5E-04 | 3.2E-04 |
| Zinc | 43.38254963 | 1.00 | 1.7E-06 | 0.02 | 1.6E-06 | 3.0E-01 | 5.7E-06 | 5.2E-06 | 1.1E-05 |
| Chloride | 54.3014319 | | | | | | | | |
| Nitrogen, Ammonia | 78.05334668 | 0.71 | 2.2E-06 | 0.05 | 7.7E-06 | 3.7E-01 | 5.9E-06 | 2.1E-05 | 2.7E-05 |
| Sulfate as SO4 | 1898.499298 | | | | | | | | |
| | | | | | SUMMARY HAZARD INDEX | | 3E-03 | 6E-03 | 9E-03 |

UWSSIDAL
DIRECT CONTACT AND INCIDENTAL INGESTION OF SURFACE SOIL - ENTIRE SITE (EXLUDING SULFATE LANDFILL)
RECEPTOR: UTILITY WORKER - CURRENT AND FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-7

09-Jun-97

**EXPOSURE PARAMETERS**

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| CONCENTRATION SOIL | $[OHM]_{soil}$ | chemical specific | chemical-specific | |
| INGESTION RATE | IR | 500 | mg-soil/day | MADEP, 1995 |
| ADHERENCE FACTOR | AF | 0.51 | mg-soil/cm²-skin | MADEP, 1995 |
| AVERAGE SURFACE AREA (1) | SA | 5,200 | cm²/day | calculated per MADEP, 1995 |
| RELATIVE ABSORPTION FACTOR-ORAL | RAF-O | chemical specific | unitless | MADEP, 1994, 1995 |
| RELATIVE ABSORPTION FACTOR -DERM | RAF-D | chemical specific | unitless | MADEP, 1994, 1995 |
| CONVERSION FACTOR | CF | 1.00E-06 | kg/mg | |
| BODY WEIGHT | BW | 70 | kg | USEPA, 1989 |
| EXPOSURE PERIOD (2) | EP | 2.74E-02 | years | Assumption |
| EXPOSURE FREQUENCY (2) | EF | 10 | events/year | Assumption |
| EXPOSURE DURATION | ED | 1 | day/event | Assumption |
| AVERAGING PERIOD | | | | |
| CANCER | AP | 75 | years | MADEP, 1995 |
| NONCANCER | AP | 2.74E-02 | years | Assumption |

(1) 50th percentile of surface areas for males: heads, hands, arms.
(2) 5 days per week for 2 weeks.

MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
MADEP, 1995. Guidance for Disposal Site Risk Characterization. Interim Final Policy WSC/ORS-95-141. July 1995.
USEPA, 1989. Exposure Factors Handbook:EPA/600/8-89/043. May 1989

**EQUATIONS**

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)^-1

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE-INGESTION} = \frac{[OHM]soil \times IR \times RAF\text{-}O \times CF \times EF \times ED \times EP}{BW \times AP \times 365\ \text{days/yr}}$$

$$\text{INTAKE-DERMAL} = \frac{[OHM]soil \times SA \times AF \times RAF\text{-}D \times EF \times ED \times EP \times CF}{BW \times AP \times 365\ \text{days/yr}}$$

UWSSIDAL
DIRECT CONTACT AND INCIDENTAL INGESTION OF SURFACE SOIL - ENTIRE SITE (EXLUDING SULFATE LANDFILL)
RECEPTOR: UTILITY WORKER - CURRENT AND FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-7

09-Jun-97

CARCINOGENIC EFFECTS

| | SOIL CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | CANCER SLOPE FACTOR (mg/kg-day)^-1 | CANCER RISK INGESTION | CANCER RISK DERMAL | TOTAL CANCER RISK |
|---|---|---|---|---|---|---|---|---|---|
| 1,1-Dichloroethene | 0.0009804 | 1.02 | 7.1E-14 | 0.10 | 3.8E-14 | 6.0E-01 | 4.3E-14 | 2.3E-14 | 6.6E-14 |
| Methylene Chloride | 0.002680076 | 1.00 | 1.9E-13 | 0.10 | 1.0E-13 | 7.5E-03 | 1.4E-15 | 7.6E-16 | 2.2E-15 |
| Tetrachloroethene (PCE) | 0.00187224 | 1.00 | 1.3E-13 | 0.10 | 7.1E-14 | 5.1E-02 | 6.8E-15 | 3.6E-15 | 1.0E-14 |
| 2-Methylphenol (o-Cresol) | 0.0060515 | | | | | ND | | | |
| Benzo(a)Anthracene | 0.97406979 | 1.00 | 7.0E-11 | 0.20 | 7.4E-11 | 7.3E-01 | 5.1E-11 | 5.4E-11 | 1.0E-10 |
| Benzo(a)Pyrene | 0.71003095 | 1.00 | 5.1E-11 | 0.20 | 5.4E-11 | 7.3E+00 | 3.7E-10 | 3.9E-10 | 7.6E-10 |
| Benzo(b)Fluoranthene | 0.456302246 | 1.00 | 3.3E-11 | 0.20 | 3.5E-11 | 7.3E-01 | 2.4E-11 | 2.5E-11 | 4.9E-11 |
| Benzo(k)Fluoranthene | 0.5212271 | 1.00 | 3.7E-11 | 0.20 | 4.0E-11 | 7.3E-02 | 2.7E-12 | 2.9E-12 | 5.6E-12 |
| Butylbenzylphthalate | 0.193246212 | | | | | ND | | | |
| Chrysene | 1.095360584 | 1.00 | 7.8E-11 | 0.20 | 8.3E-11 | 7.3E-03 | 5.7E-13 | 6.1E-13 | 1.2E-12 |
| Indeno (1,2,3-cd)Pyrene | 0.25962265 | 1.00 | 1.9E-11 | 0.20 | 2.0E-11 | 7.3E-01 | 1.4E-11 | 1.4E-11 | 2.8E-11 |
| N-Nitrosodiphenylamine | 1.051156552 | 0.91 | 6.8E-11 | 0.17 | 6.8E-11 | 4.9E-03 | 3.4E-13 | 3.3E-13 | 6.7E-13 |
| bis(2-EthylHexyl)phthalate | 37.72849104 | 1.00 | 2.7E-09 | 0.02 | 2.9E-10 | 1.4E-02 | 3.8E-11 | 4.0E-12 | 4.2E-11 |
| 4,4'-DDD | 0.013510286 | 1.00 | 9.7E-13 | 0.20 | 1.0E-12 | 2.4E-01 | 2.3E-13 | 2.5E-13 | 4.8E-13 |
| 4,4'-DDE | 0.01495768 | 1.00 | 1.1E-12 | 0.20 | 1.1E-12 | 3.4E-01 | 3.6E-13 | 3.9E-13 | 7.5E-13 |
| 4,4'-DDT | 0.096925784 | 1.00 | 6.9E-12 | 0.20 | 7.4E-12 | 3.4E-01 | 2.4E-12 | 2.5E-12 | 4.9E-12 |
| Aldrin | 0.00081635 | 1.00 | 5.8E-14 | 0.25 | 7.7E-14 | 1.7E+01 | 9.9E-13 | 1.3E-12 | 2.3E-12 |
| Alpha-BHC | 0.001541392 | 0.96 | 1.1E-13 | 0.18 | 1.0E-13 | 6.3E+00 | 6.6E-13 | 6.6E-13 | 1.3E-12 |
| Alpha-Chlordane | 0.001231571 | 1.00 | 8.8E-14 | 0.05 | 2.3E-14 | 1.3E+00 | 1.1E-13 | 3.0E-14 | 1.4E-13 |
| Dieldrin | 0.000780928 | 1.00 | 5.6E-14 | 0.25 | 7.4E-14 | 1.6E+01 | 8.9E-13 | 1.2E-12 | 2.1E-12 |
| Gamma-BHC (Lindane) | 0.007240963 | 1.00 | 5.2E-13 | 0.20 | 5.5E-13 | 1.3E+00 | 6.7E-13 | 7.1E-13 | 1.4E-12 |
| Gamma-Chlordane | 0.001274346 | 1.00 | 9.1E-14 | 0.05 | 2.4E-14 | 1.3E+00 | 1.2E-13 | 3.1E-14 | 1.5E-13 |
| Heptachlor | 0.000056654 | 1.00 | 4.1E-15 | 0.20 | 4.3E-15 | 4.5E+00 | 1.8E-14 | 1.9E-14 | 3.8E-14 |
| Heptachlor Epoxide | 0.0001206 | 1.00 | 8.6E-15 | 0.20 | 9.1E-15 | 9.1E+00 | 7.8E-14 | 8.3E-14 | 1.6E-13 |
| PCB-1016 | 0.0156408 | 0.85 | 9.5E-13 | 0.07 | 4.2E-13 | 2.0E+00 | 1.9E-12 | 8.3E-13 | 2.7E-12 |
| Arsenic | 9.554368578 | 1.00 | 6.8E-10 | 0.03 | 1.1E-10 | 1.5E+00 | 1.0E-09 | 1.6E-10 | 1.2E-09 |
| Beryllium | 0.037884618 | 1.00 | 2.7E-12 | 0.03 | 4.3E-13 | 4.3E+00 | 1.2E-11 | 1.9E-12 | 1.3E-11 |
| Cadmium | 0.4091042 | | | | | ND | | | |
| Lead | 44.89659863 | | | | | ND | | | |
| | | | | | SUMMARY CANCER RISK | | 2E-09 | 7E-10 | 2E-09 |

[1] MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
ND = no data available

UWSSIDAL
DIRECT CONTACT AND INCIDENTAL INGESTION OF SURFACE SOIL - ENTIRE SITE (EXLUDING SULFATE LANDFILL)
RECEPTOR: UTILITY WORKER - CURRENT AND FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-7

09-Jun-97

NONCARCINOGENIC EFFECTS

| COMPOUND | SOIL CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | SUBCHRONIC RfD (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|
| 1,1,1-Trichloroethane | 0.006324323 | 1.00 | 1.2E-09 | 0.10 | 6.6E-10 | 9.0E-02 | 1.4E-08 | 7.3E-09 | 2.1E-08 |
| 1,1-Dichloroethene | 0.0009804 | 1.00 | 1.9E-10 | 0.10 | 1.0E-10 | 9.0E-03 | 2.1E-08 | 1.1E-08 | 3.3E-08 |
| 2,4,4-Trimethyl-1-pentene | 0.00053105 | 0.99 | 1.0E-10 | 0.11 | 6.1E-11 | 2.1E-01 | 5.0E-10 | 3.0E-10 | 8.0E-10 |
| 2-Butanone (MEK) | 0.000517312 | 1.00 | 1.0E-10 | 0.10 | 5.4E-11 | 2.0E+00 | 5.1E-11 | 2.7E-11 | 7.7E-11 |
| Acetone | 0.007891954 | 1.00 | 1.5E-09 | 0.10 | 8.2E-10 | 1.0E+00 | 1.5E-09 | 8.2E-10 | 2.4E-09 |
| Methylene Chloride | 0.002680076 | 1.00 | 5.2E-10 | 0.10 | 2.8E-10 | 6.0E-02 | 8.7E-09 | 4.6E-09 | 1.3E-08 |
| Tetrachloroethene (PCE) | 0.00187224 | 1.00 | 3.7E-10 | 0.10 | 1.9E-10 | 1.0E-01 | 3.7E-09 | 1.9E-09 | 5.6E-09 |
| Toluene | 0.003269972 | 1.00 | 6.4E-10 | 0.12 | 4.1E-10 | 2.0E+00 | 3.2E-10 | 2.0E-10 | 5.2E-10 |
| 2-Methylnaphthalene | 3.38426955 | 1.00 | 6.6E-07 | 0.20 | 7.0E-07 | 3.0E-02 | 2.2E-05 | 2.3E-05 | 4.5E-05 |
| 2-Methylphenol (o-Cresol) | 0.0060515 | 1.00 | 1.2E-09 | 0.19 | 1.2E-09 | 5.0E-01 | 2.4E-09 | 2.3E-09 | 4.7E-09 |
| Acenaphthene | 1.04778635 | 1.00 | 2.1E-07 | 0.20 | 2.2E-07 | 6.0E-01 | 3.4E-07 | 3.6E-07 | 7.0E-07 |
| Acenaphthylene | 2.559277806 | 0.91 | 4.6E-07 | 0.18 | 4.8E-07 | 3.0E-02 | 1.5E-05 | 1.6E-05 | 3.1E-05 |
| Anthracene | 1.785742086 | 1.00 | 3.5E-07 | 0.29 | 5.4E-07 | 3 0E+00 | 1.2E-07 | 1.8E-07 | 3.0E-07 |
| Benzo(a)Anthracene | 0.97406979 | 0.91 | 1.7E-07 | 0.18 | 1.8E-07 | 3 0E-02 | 5.8E-06 | 6.1E-06 | 1.2E-05 |
| Benzo(a)Pyrene | 0.71003095 | 0.91 | 1.3E-07 | 0.18 | 1.3E-07 | 3.0E-02 | 4.2E-06 | 4.4E-06 | 8.6E-06 |
| Benzo(b)Fluoranthene | 0.456302246 | 0.91 | 8.1E-08 | 0.18 | 8.5E-08 | 3.0E-02 | 2.7E-06 | 2.8E-06 | 5.6E-06 |
| Benzo(g,h,i)Perylene | 0.28812645 | 0.91 | 5.1E-08 | 0.18 | 5.4E-08 | 3.0E-02 | 1.7E-06 | 1.8E-06 | 3.5E-06 |
| Benzo(k)Fluoranthene | 0.5212271 | 0.91 | 9.3E-08 | 0.18 | 9.7E-08 | 3.0E-02 | 3.1E-06 | 3.2E-06 | 6.3E-06 |
| Benzoic Acid | 0.404715488 | 0.96 | 7.6E-08 | 0.18 | 7.5E-08 | 4.0E+00 | 1.9E-08 | 1.9E-08 | 3.8E-08 |
| Butylbenzylphthalate | 0.193246212 | 0.96 | 3.6E-08 | 0.18 | 3.6E-08 | 2.0E+00 | 1.8E-08 | 1.8E-08 | 3.6E-08 |
| Chrysene | 1.095360584 | 0.91 | 2.0E-07 | 0.18 | 2.0E-07 | 3.0E-02 | 6.5E-06 | 6.8E-06 | 1.3E-05 |
| Di-n-butylphthalate | 0.279702126 | 0.96 | 5.2E-08 | 0.18 | 5.2E-08 | 1.0E+00 | 5.2E-08 | 5.2E-08 | 1.0E-07 |
| Di-n-octylphthalate | 0.082199416 | 0.96 | 1.5E-08 | 0.18 | 1.5E-08 | 2.0E-02 | 7.7E-07 | 7.6E-07 | 1.5E-06 |
| Dibenzofuran | 0.277474248 | 1.00 | 5.4E-08 | 0.19 | 5.4E-08 | 3.0E-02 | 1.8E-06 | 1.8E-06 | 3.6E-06 |
| Diethylphthalate | 0.038086766 | 1.00 | 7.5E-09 | 0.02 | 7.9E-10 | 8.0E+00 | 9.3E-10 | 9.9E-11 | 1.0E-09 |
| Fluoranthene | 2.677110124 | 1.00 | 5.2E-07 | 0.20 | 5.6E-07 | 4.0E-01 | 1.3E-06 | 1.4E-06 | 2.7E-06 |
| Fluorene | 2.57569671 | 1.00 | 5.0E-07 | 0.20 | 5.3E-07 | 4.0E-01 | 1.3E-06 | 1.3E-06 | 2.6E-06 |
| Indeno (1,2,3-cd)Pyrene | 0.25962265 | 0.91 | 4.6E-08 | 0.18 | 4.9E-08 | 3.0E-02 | 1.5E-06 | 1.6E-06 | 3.2E-06 |
| N-Nitrosodiphenylamine | 1.051156552 | 0.96 | 2.0E-07 | 0.18 | 2.0E-07 | 5.0E-02 | 3.9E-06 | 3.9E-06 | 7.8E-06 |
| Naphthalene | 3.356851364 | 1.00 | 6.6E-07 | 0.10 | 3.5E-07 | 4 0E-02 | 1.6E-05 | 8.7E-06 | 2.5E-05 |
| Phenanthrene | 6.362283244 | 0.91 | 1.1E-06 | 0.18 | 1.2E-06 | 3.0E-02 | 3.8E-05 | 4.0E-05 | 7.7E-05 |
| Phenol | 0.337041 | 1.00 | 6.6E-08 | 0.26 | 9.1E-08 | 6.0E-01 | 1.1E-07 | 1.5E-07 | 2.6E-07 |

[1] MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
ND = no data available

UWSSIDAL
DIRECT CONTACT AND INCIDENTAL INGESTION OF SURFACE SOIL - ENTIRE SITE (EXLUDING SULFATE LANDFILL)
RECEPTOR: UTILITY WORKER - CURRENT AND FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-7

09-Jun-97

NONCARCINOGENIC EFFECTS

| COMPOUND | SOIL CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | SUBCHRONIC RfD (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|
| Pyrene | 2.174239158 | 1.00 | 4.3E-07 | 0.20 | 4.5E-07 | 3.0E-01 | 1.4E-06 | 1.5E-06 | 2.9E-06 |
| bis(2-Ethyl(Hexyl)phthalate | 37.72849104 | 1.00 | 7.4E-06 | 0.02 | 7.8E-07 | 2.0E-02 | 3.7E-04 | 3.9E-05 | 4.1E-04 |
| 4,4'-DDD | 0.013510286 | 0.96 | 2.5E-09 | 0.18 | 2.5E-09 | 5.0E-04 | 5.1E-06 | 5.0E-06 | 1.0E-05 |
| 4,4'-DDE | 0.01495768 | 0.96 | 2.8E-09 | 0.18 | 2.8E-09 | 5.0E-04 | 5.6E-06 | 5.6E-06 | 1.1E-05 |
| 4,4'-DDT | 0.096925784 | 0.96 | 1.8E-08 | 0.18 | 1.8E-08 | 5.0E-04 | 3.6E-05 | 3.6E-05 | 7.2E-05 |
| Aldrin | 0.00081635 | 1.00 | 1.6E-10 | 0.25 | 2.1E-10 | 3.0E-05 | 5.3E-06 | 7.1E-06 | 1.2E-05 |
| Alpha-BHC | 0.001541392 | 0.96 | 2.9E-10 | 0.18 | 2.9E-10 | 5.0E-04 | 5.8E-07 | 5.7E-07 | 1.2E-06 |
| Alpha-Chlordane | 0.001231571 | 1.00 | 2.4E-10 | 0.05 | 6.4E-11 | 6.0E-05 | 4.0E-06 | 1.1E-06 | 5.1E-06 |
| Dieldrin | 0.000780928 | 1.00 | 1.5E-10 | 0.25 | 2.0E-10 | 5.0E-05 | 3.1E-06 | 4.1E-06 | 7.1E-06 |
| Endosulfan I | 0.001311112 | 0.96 | 2.5E-10 | 0.18 | 2.4E-10 | 6.0E-03 | 4.1E-08 | 4.1E-08 | 8.2E-08 |
| Endosulfan II | 0.00353234 | 0.96 | 6.6E-10 | 0.18 | 6.6E-10 | 6.0E-03 | 1.1E-07 | 1.1E-07 | 2.2E-07 |
| Endrin | 0.001643931 | 1.00 | 3.2E-10 | 0.25 | 4.3E-10 | 3.0E-04 | 1.1E-06 | 1.4E-06 | 2.5E-06 |
| Endrin Ketone | 0.000729454 | 0.96 | 1.4E-10 | 0.18 | 1.4E-10 | 3.0E-04 | 4.6E-07 | 4.5E-07 | 9.1E-07 |
| Gamma-BHC (Lindane) | 0.007240963 | 1.00 | 1.4E-09 | 0.20 | 1.5E-09 | 3.0E-03 | 4.7E-07 | 5.0E-07 | 9.7E-07 |
| Gamma-Chlordane | 0.001274346 | 1.00 | 2.5E-10 | 0.05 | 6.6E-11 | 6.0E-05 | 4.2E-06 | 1.1E-06 | 5.3E-06 |
| Heptachlor | 0.000056654 | 1.00 | 1.1E-11 | 0.20 | 1.2E-11 | 5.0E-04 | 2.2E-08 | 2.4E-08 | 4.6E-08 |
| Heptachlor Epoxide | 0.0001206 | 1.00 | 2.4E-11 | 0.20 | 2.5E-11 | 1.3E-05 | 1.8E-06 | 1.9E-06 | 3.7E-06 |
| PCB-1016 | 0.0156408 | 0.96 | 2.9E-09 | 0.18 | 2.9E-09 | 7.0E-05 | 4.2E-05 | 4.2E-05 | 8.3E-05 |
| Aluminum | 5693.433555 | | | | | | | | |
| Antimony | 1.696626612 | 1.00 | 3.3E-07 | 0.10 | 1.8E-07 | 4.0E-04 | 8.3E-04 | 4.4E-04 | 1.3E-03 |
| Arsenic | 9.554368578 | 1.00 | 1.9E-06 | 0.03 | 3.0E-07 | 3.0E-04 | 6.2E-03 | 9.9E-04 | 7.2E-03 |
| Barium | 21.64126823 | 0.71 | 3.0E-06 | 0.05 | 1.2E-06 | 7.0E-02 | 4.3E-05 | 1.8E-05 | 6.0E-05 |
| Beryllium | 0.037884618 | 1.00 | 7.4E-09 | 0.03 | 1.2E-09 | 5.0E-03 | 1.5E-06 | 2.4E-07 | 1.7E-06 |
| Cadmium | 0.4091042 | 1.00 | 8.0E-08 | 0.14 | 5.9E-08 | 5.0E-04 | 1.6E-04 | 1.2E-04 | 2.8E-04 |
| Calcium | 2380.75896 | | | | | | | | |
| Chromium III | 146.25945 | 1.00 | 2.9E-05 | 0.04 | 6.1E-06 | 1.0E+00 | 2.9E-05 | 6.1E-06 | 3.5E-05 |
| Chromium VI | 16.25105122 | 1.00 | 3.2E-06 | 0.09 | 1.5E-06 | 2.0E-02 | 1.6E-04 | 7.6E-05 | 2.3E-04 |
| Cobalt | 3.020114384 | 1.86 | 1.1E-06 | 0.14 | 4.5E-07 | 6.0E-02 | 1.8E-05 | 7.5E-06 | 2.6E-05 |
| Cyanide | 0.202692 | 1.00 | 4.0E-08 | 0.30 | 6.3E-08 | 2.0E-02 | 2.0E-06 | 3.2E-06 | 5.1E-06 |
| Iron | 8533.955256 | | | | | | | | |
| Lead | 44.89659863 | 0.50 | 4.4E-06 | 0.01 | 2.8E-07 | 7.5E-04 | 5.9E-03 | 3.7E-04 | 6.2E-03 |
| Manganese | 86.62145349 | 1.86 | 3.2E-05 | 0.14 | 1.3E-05 | 4.7E-02 | 6.7E-04 | 2.7E-04 | 9.4E-04 |
| Mercury | 0.128231552 | 1.00 | 2.5E-08 | 0.05 | 6.7E-09 | 3.0E-04 | 8.4E-05 | 2.2E-05 | 1.1E-04 |
| Nickel | 8.0484322 | 1.00 | 1.6E-06 | 0.35 | 2.9E-06 | 2.0E-02 | 7.9E-05 | 1.5E-04 | 2.2E-04 |
| Selenium | 0.633355458 | 1.00 | 1.2E-07 | 0.00 | 1.3E-09 | 5.0E-03 | 2.5E-05 | 2.6E-07 | 2.5E-05 |
| Sodium | 67.04148273 | | | | | | | | |
| Thallium | 0.546068228 | 1.00 | 1.1E-07 | 0.01 | 5.7E-09 | 8.0E-04 | 1.3E-04 | 7.1E-06 | 1.4E-04 |
| Vanadium | 17.53779468 | 0.71 | 2.4E-06 | 0.05 | 9.9E-07 | 7.0E-03 | 3.5E-04 | 1.4E-04 | 4.9E-04 |
| Zinc | 43.38254963 | 1.00 | 8.5E-06 | 0.02 | 9.0E-07 | 3.0E-01 | 2.8E-05 | 3.0E-06 | 3.1E-05 |
| Chloride | 54.3014319 | | | | | | | | |
| Nitrogen, Ammonia | 78.05334668 | 0.71 | 1.1E-05 | 0.05 | 4.4E-06 | 3.7E-01 | 2.9E-05 | 1.2E-05 | 4.1E-05 |
| Sulfate as SO4 | 1898.499298 | | | | | | | | |
| SUMMARY HAZARD INDEX | | | | | | | 2E-02 | 3E-03 | 2E-02 |

[1] MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
ND = no data available

UWSSINAL
INHALATION EXPOSURE TO OHM IN SURFACE SOIL PARTICULATES - ENTIRE SITE (EXCLUDING SULFATE LANDFILL)
RECEPTOR: UTILITY WORKER - CURRENT AND FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-8

09-Jun-97

EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| CONCENTRATION IN AIR | [RP]air | 60 | ug/m3 | MADEP, 1995 |
| CONCENTRATION IN SOIL | [OHM]part | chemical-specific | mg/kg | |
| CONVERSION FACTOR 1 | CF1 | 24 | hours/day | |
| EXPOSURE TIME DAILY | ET | 8 | hours/day | Assumption |
| EXPOSURE FREQUENCY (1) | EF | 10 | days/year | Assumption |
| EXPOSURE DURATION (1) | ED | 0.0274 | years | Assumption |
| CONVERSION FACTOR 2 | CF2 | 365 | days/year | |
| CONVERSION FACTOR 3 | CF3 | 0.000001 | kg/mg | |
| AVERAGING TIME CANCER | AT | 75 | years | MADEP, 1995 |
| AVERAGING TIME NONCANCER | AT | 0.0274 | years | Assumption |

(1) 5 days per week for 2 weeks.

MADEP, 1995. Guidance for Disposal Site Risk Characterization, Interim Final Policy WSC/ORS-95-141. July.

EQUATIONS

CANCER RISK = AVG. CONC. (ug/m3) * CANCER UNIT RISK (ug/m3)^-1

HAZARD QUOTIENT = AVG.CONC.(ug/m3)/REF. CONC. (ug/m3)

$$\text{AVG. EXPOSURE CONC.} = \frac{[OHM]air * EF * ET * ED}{AT * CF1 * CF2}$$

OHM AIR CONC. = [RP]air * [OHM]part * CF3

Note:

*For noncarcinogenic effects: AT = ED

UWSSINAL
INHALATION EXPOSURE TO OHM IN SURFACE SOIL PARTICULATES - ENTIRE SITE (EXCLUDING SULFATE LANDFILL)
RECEPTOR: UTILITY WORKER - CURRENT AND FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-8

09-Jun-97

CARCINOGENIC EFFECTS

| COMPOUND | OHM SOIL CONCENTRATION (mg/kg) | OHM AIR CONCENTRATION (ug/m3) | AVERAGE AIR CONCENTRATION LIFETIME (ug/m3) | INHALATION CANCER UNIT RISK (ug/m3)^-1 | CANCER RISK |
|---|---|---|---|---|---|
| 1,1-Dichloroethene | 0.0009804 | 5.8824E-08 | 2.0E-13 | 5.0E-05 | 9.8E-18 |
| Methylene Chloride | 0.002680076 | 1.60805E-07 | 5.4E-13 | 4.7E-07 | 2.5E-19 |
| Tetrachloroethene (PCE) | 0.00187224 | 1.12334E-07 | 3.7E-13 | 5.9E-06 | 2.2E-18 |
| 2-Methylphenol (o-Cresol) | 0.0060515 | 3.6309E-07 | 1.2E-12 | ND | |
| Benzo(a)Anthracene | 0.97406979 | 5.84442E-05 | 1.9E-10 | 1.1E-04 | 2.1E-14 |
| Benzo(a)Pyrene | 0.71003095 | 4.26019E-05 | 1.4E-10 | 1.1E-03 | 1.6E-13 |
| Benzo(b)Fluoranthene | 0.456302246 | 2.73781E-05 | 9.1E-11 | 1.1E-04 | 1.0E-14 |
| Benzo(k)Fluoranthene | 0.5212271 | 3.12736E-05 | 1.0E-10 | 1.1E-05 | 1.1E-15 |
| Butylbenzylphthalate | 0.193246212 | 1.15948E-05 | 3.9E-11 | ND | |
| Chrysene | 1.095360584 | 6.57216E-05 | 2.2E-10 | 1.1E-06 | 2.4E-16 |
| Indeno (1,2,3-cd)Pyrene | 0.25962265 | 1.55774E-05 | 5.2E-11 | 1.1E-04 | 5.7E-15 |
| N-Nitrosodiphenylamine | 1.051156552 | 6.30694E-05 | 2.1E-10 | 2.6E-06 | 5.5E-16 |
| bis(2-EthylHexyl)phthalate | 37.72849104 | 0.002263709 | 7.6E-09 | 2.4E-06 | 1.8E-14 |
| 4,4'-DDD | 0.013510286 | 8.10617E-07 | 2.7E-12 | 9.7E-05 | 2.6E-16 |
| 4,4'-DDE | 0.01495768 | 8.97461E-07 | 3.0E-12 | 9.7E-05 | 2.9E-16 |
| 4,4'-DDT | 0.096925784 | 5.81555E-06 | 1.9E-11 | 9.7E-05 | 1.9E-15 |
| Aldrin | 0.00081635 | 4.8981E-08 | 1.6E-13 | 4.9E-03 | 8.0E-16 |
| Alpha-BHC | 0.001541392 | 9.24835E-08 | 3.1E-13 | 1.8E-03 | 5.6E-16 |
| Alpha-Chlordane | 0.001231571 | 7.38942E-08 | 2.5E-13 | 3.7E-04 | 9.1E-17 |
| Dieldrin | 0.000780928 | 4.68557E-08 | 1.6E-13 | 4.6E-03 | 7.2E-16 |
| Gamma-BHC (Lindane) | 0.007240963 | 4.34458E-07 | 1.4E-12 | 1.8E-05 | 2.7E-17 |
| Gamma-Chlordane | 0.001274346 | 7.64607E-08 | 2.6E-13 | 3.7E-04 | 9.4E-17 |
| Heptachlor | 0.000056654 | 3.39924E-09 | 1.1E-14 | 1.3E-03 | 1.5E-17 |
| Heptachlor Epoxide | 0.0001206 | 7.236E-09 | 2.4E-14 | 2.6E-03 | 6.3E-17 |
| PCB-1016 | 0.0156408 | 9.38448E-07 | 3.1E-12 | ND | |
| Arsenic | 9.554368578 | 0.000573262 | 1.9E-09 | 4.3E-03 | 8.2E-12 |
| Beryllium | 0.037884618 | 2.27308E-06 | 7.6E-12 | 2.4E-03 | 1.8E-14 |
| Cadmium | 0.4091042 | 2.45463E-05 | 8.2E-11 | 1.8E-03 | 1.5E-13 |
| Chromium VI | 16.25105122 | 0.000975063 | 3.3E-09 | 1.2E-02 | 3.9E-11 |
| Lead | 44.89659863 | 0.002693796 | 9.0E-09 | ND | |
| Nickel | 8.0484322 | 0.000482906 | 1.6E-09 | 2.4E-04 | 3.9E-13 |
| | | | | SUMMARY CANCER RISK | 5E-11 |

ND = No data available.

UWSSINAL
INHALATION EXPOSURE TO OHM IN SURFACE SOIL PARTICULATES - ENTIRE SITE (EXCLUDING SULFATE LANDFILL)
RECEPTOR: UTILITY WORKER - CURRENT AND FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-8

09-Jun-97

NONCARCINOGENIC EFFECTS

| COMPOUND | OHM SOIL CONCENTRATION (mg/kg) | OHM AIR CONCENTRATION (ug/m3) | AVERAGE AIR CONCENTRATION FOR TIME PERIOD (ug/m3) | SUBCHRONIC INHALATION RfC [1] (ug/m3) | HAZARD QUOTIENT |
|---|---|---|---|---|---|
| 1,1,1-Trichloroethane | 0.006324323 | 3.79459E-07 | 3.5E-09 | 1000 | 3.5E-12 |
| 1,1-Dichloroethene | 0.0009804 | 5.8824E-08 | 5.4E-10 | 50 | 1.1E-11 |
| 2,4,4-Trimethyl-1-pentene | 0.00053105 | 3.1863E-08 | 2.9E-10 | 717.5 | 4.1E-13 |
| 2-Butanone (MEK) | 0.000517312 | 3.10387E-08 | 2.8E-10 | 1000 | 2.8E-13 |
| Acetone | 0.007891954 | 4.73517E-07 | 4.3E-09 | 800 | 5.4E-12 |
| Methylene Chloride | 0.002680076 | 1.60805E-07 | 1.5E-09 | 3000 | 4.9E-13 |
| Tetrachloroethene (PCE) | 0.00187224 | 1.12334E-07 | 1.0E-09 | 4600 | 2.2E-13 |
| Toluene | 0.003269972 | 1.96198E-07 | 1.8E-09 | 400 | 4.5E-12 |
| 2-Methylnaphthalene | 3.38426955 | 0.000203056 | 1.9E-06 | 71 | 2.6E-08 |
| 2-Methylphenol (o-Cresol) | 0.0060515 | 3.6309E-07 | 3.3E-09 | 100 | 3.3E-11 |
| Acenaphthene | 1.04778635 | 6.28672E-05 | 5.7E-07 | 71 | 8.1E-09 |
| Acenaphthylene | 2.559277806 | 0.000153557 | 1.4E-06 | 71 | 2.0E-08 |
| Anthracene | 1.785742086 | 0.000107145 | 9.8E-07 | 71 | 1.4E-08 |
| Benzo(a)Anthracene | 0.97406979 | 5.84442E-05 | 5.3E-07 | 71 | 7.5E-09 |
| Benzo(a)Pyrene | 0.71003095 | 4.26019E-05 | 3.9E-07 | 71 | 5.5E-09 |
| Benzo(b)Fluoranthene | 0.456302246 | 2.73781E-05 | 2.5E-07 | 71 | 3.5E-09 |
| Benzo(g,h,i)Perylene | 0.28812645 | 1.72876E-05 | 1.6E-07 | 71 | 2.2E-09 |
| Benzo(k)Fluoranthene | 0.5212271 | 3.12736E-05 | 2.9E-07 | 71 | 4.0E-09 |
| Benzoic Acid | 0.404715488 | 2.42829E-05 | 2.2E-07 | | |
| Butylbenzylphthalate | 0.193246212 | 1.15948E-05 | 1.1E-07 | 7 | 1.5E-08 |
| Chrysene | 1.095360584 | 6.57216E-05 | 6.0E-07 | 71 | 8.5E-09 |
| Di-n-butylphthalate | 0.279702126 | 1.67821E-05 | 1.5E-07 | 7 | 2.2E-08 |
| Di-n-octylphthalate | 0.082199416 | 4.93196E-06 | 4.5E-08 | 7 | 6.4E-09 |
| Dibenzofuran | 0.277474248 | 1.66485E-05 | 1.5E-07 | | |
| Diethylphthalate | 0.038086766 | 2.28521E-06 | 2.1E-08 | 7 | 3.0E-09 |
| Fluoranthene | 2.677110124 | 0.000160627 | 1.5E-06 | 71 | 2.1E-08 |
| Fluorene | 2.57569671 | 0.000154542 | 1.4E-06 | 71 | 2.0E-08 |
| Indeno (1,2,3-cd)Pyrene | 0.25962265 | 1.55774E-05 | 1.4E-07 | 71 | 2.0E-09 |
| N-Nitrosodiphenylamine | 1.051156552 | 6.30694E-05 | 5.8E-07 | | |
| Naphthalene | 3.356851364 | 0.000201411 | 1.8E-06 | 71 | 2.6E-08 |
| Phenanthrene | 6.362283244 | 0.000381737 | 3.5E-06 | 71 | 4.9E-08 |
| Phenol | 0.337041 | 2.02225E-05 | 1.8E-07 | 260 | 7.1E-10 |
| Pyrene | 2.174239158 | 0.000130454 | 1.2E-06 | 71 | 1.7E-08 |
| bis(2-EthylHexyl)phthalate | 37.72849104 | 0.002263709 | 2.1E-05 | 7 | 3.0E-06 |
| 4,4'-DDD | 0.013510286 | 8.10617E-07 | 7.4E-09 | | |
| 4,4'-DDE | 0.01495768 | 8.97461E-07 | 8.2E-09 | | |
| 4,4'-DDT | 0.096925784 | 5.81555E-06 | 5.3E-08 | | |

UWSSINAL
INHALATION EXPOSURE TO OHM IN SURFACE SOIL PARTICULATES - ENTIRE SITE (EXCLUDING SULFATE LANDFILL)
RECEPTOR: UTILITY WORKER - CURRENT AND FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-8

09-Jun-97

NONCARCINOGENIC EFFECTS

| COMPOUND | OHM SOIL CONCENTRATION mg/kg | OHM AIR CONCENTRATION (mg/m3) | AVERAGE AIR CONCENTRATION FOR TIME PERIOD (mg/m3) | SUBCHRONIC INHALATION RfC [1] (mg/m3) | HAZARD QUOTIENT |
|---|---|---|---|---|---|
| Aldrin | 0.00081635 | 4.8981E-08 | 4.5E-10 | | |
| Alpha-BHC | 0.001541392 | 9.24835E-08 | 8.4E-10 | 0.7 | 1.2E-09 |
| Alpha-Chlordane | 0.001231571 | 7.38942E-08 | 6.7E-10 | 0.7 | 9.6E-10 |
| Dieldrin | 0.000780928 | 4.68557E-08 | 4.3E-10 | | |
| Endosulfan I | 0.001311112 | 7.86667E-08 | 7.2E-10 | | |
| Endosulfan II | 0.00353234 | 2.1194E-07 | 1.9E-09 | | |
| Endrin | 0.001643931 | 9.86359E-08 | 9.0E-10 | | |
| Endrin Ketone | 0.000729454 | 4.37672E-08 | 4.0E-10 | | |
| Gamma-BHC (Lindane) | 0.007240963 | 4.34458E-07 | 4.0E-09 | 0.7 | 5.7E-09 |
| Gamma-Chlordane | 0.001274346 | 7.64607E-08 | 7.0E-10 | 0.7 | 1.0E-09 |
| Heptachlor | 0.000056654 | 3.39924E-09 | 3.1E-11 | 0.7 | 4.4E-11 |
| Heptachlor Epoxide | 0.0001206 | 7.236E-09 | 6.6E-11 | 0.7 | 9.4E-11 |
| PCB-1016 | 0.0156408 | 9.38448E-07 | 8.6E-09 | 0.02 | 4.3E-07 |
| Aluminum | 5693.433555 | 0.341606013 | 3.1E-03 | | |
| Antimony | 1.696626612 | 0.000101798 | 9.3E-07 | 10 | 9.3E-08 |
| Arsenic | 9.554368578 | 0.000573262 | 5.2E-06 | 0.0025 | 2.1E-03 |
| Barium | 21.64126823 | 0.001298476 | 1.2E-05 | 5 | 2.4E-06 |
| Beryllium | 0.037884618 | 2.27308E-06 | 2.1E-08 | 0.005 | 4.2E-06 |
| Cadmium | 0.4091042 | 2.45463E-05 | 2.2E-07 | 0.2 | 1.1E-06 |
| Calcium | 2380.75896 | 0.142845538 | 1.3E-03 | | |
| Chromium III | 146.25945 | 0.008775567 | 8.0E-05 | 6.8 | 1.2E-05 |
| Chromium VI | 16.25105122 | 0.000975063 | 8.9E-06 | 0.02 | 4.5E-04 |
| Cobalt | 3.020114384 | 0.000181207 | 1.7E-06 | | |
| Cyanide | 0.202692 | 1.21615E-05 | 1.1E-07 | 7 | 1.6E-08 |
| Iron | 8533.955256 | 0.512037315 | 4.7E-03 | | |
| Lead | 44.89659863 | 0.002693796 | 2.5E-05 | 0.7 | 3.5E-05 |
| Manganese | 86.62145349 | 0.005197287 | 4.7E-05 | 0.05 | 9.5E-04 |
| Mercury | 0.128231552 | 7.69389E-06 | 7.0E-08 | 0.3 | 2.3E-07 |
| Nickel | 8.0484322 | 0.000482906 | 4.4E-06 | 0.009 | 4.9E-04 |
| Selenium | 0.633355458 | 3.80013E-05 | 3.5E-07 | 2.7 | 1.3E-07 |
| Sodium | 67.04148273 | 0.004022489 | 3.7E-05 | | |
| Thallium | 0.546068228 | 3.27641E-05 | 3.0E-07 | | |
| Vanadium | 17.53779468 | 0.001052268 | 9.6E-06 | 6 | 1.6E-06 |
| Zinc | 43.38254963 | 0.002602953 | 2.4E-05 | | |
| Chloride | 54.3014319 | 0.003258086 | 3.0E-05 | | |
| Nitrogen, Ammonia | 78.05334668 | 0.004683201 | 4.3E-05 | 100 | 4.3E-07 |
| Sulfate as SO4 | 1898.499298 | 0.113909958 | 1.0E-03 | | |
| | | | SUMMARY HAZARD INDEX | | 4E-03 |

ND = No data available.

CWSSIDAL
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SURFACE SOIL - ENTIRE SITE (EXLUDING SULFATE LANDFILL)
RECEPTOR: CONSTRUCTION (EXCAVATION) WORKER - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-9

09-Jun-97

EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| CONCENTRATION SOIL | $[OHM]_{soil}$ | chemical specific | chemical-specific | |
| INGESTION RATE | IR | 500 | mg-soil/day | MADEP, 1995 |
| ADHERENCE FACTOR | AF | 0.51 | mg-soil/cm²-skin | MADEP, 1995 |
| AVERAGE SURFACE AREA (1) | SA | 5,200 | cm²/day | calculated per MADEP, 1995 |
| RELATIVE ABSORPTION FACTOR-ORAL | RAF-O | chemical specific | unitless | MADEP, 1994, 1995 |
| RELATIVE ABSORPTION FACTOR -DERM | RAF-D | chemical specific | unitless | MADEP, 1994, 1995 |
| CONVERSION FACTOR | CF | 1.00E-06 | kg/mg | |
| BODY WEIGHT | BW | 70 | kg | USEPA, 1989 |
| EXPOSURE PERIOD (2) | EP | 0.167 | years | Assumption |
| EXPOSURE FREQUENCY (2) | EF | 40 | events/year | Assumption |
| EXPOSURE DURATION | ED | 1 | day/event | Assumption |
| AVERAGING PERIOD | | | | |
| CANCER | AP | 75 | years | MADEP, 1995 |
| NONCANCER | AP | 0.167 | years | Assumption |

(1) 50th percentile surface areas for males: hands, arms, head.
(2) 5 days per week for 2 months.
MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
MADEP, 1995. Guidance for Disposal Site Risk Characterization. Interim Final Policy WSC/ORS-95-141. July 1995.
USEPA, 1989. Exposure Factors Handbook.EPA/600/8-89/043. May 1989.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)^-1

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE-INGESTION} = \frac{[OHM]soil \times IR \times RAF\text{-}O \times CF \times EF \times ED \times EP}{BW \times AP \times 365\ days/yr}$$

$$\text{INTAKE-DERMAL} = \frac{[OHM]soil \times SA \times AF \times RAF\text{-}D \times EF \times ED \times EP \times CF}{BW \times AP \times 365\ days/yr}$$

CWSSIDAL
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SURFACE SOIL - ENTIRE SITE (EXLUDING SULFATE LANDFILL)
RECEPTOR: CONSTRUCTION (EXCAVATION) WORKER - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-9

09-Jun-97

CARCINOGENIC EFFECTS

| | SOIL CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | CANCER SLOPE FACTOR (mg/kg-day)^-1 | CANCER RISK INGESTION | CANCER RISK DERMAL | TOTAL CANCER RISK |
|---|---|---|---|---|---|---|---|---|---|
| 1,1-Dichloroethene | 0.0009804 | 1.02 | 1.7E-12 | 0.10 | 9.2E-13 | 6.0E-01 | 1.0E-12 | 5.5E-13 | 1.6E-12 |
| Methylene Chloride | 0.002680076 | 1.00 | 4.7E-12 | 0.10 | 2.5E-12 | 7.5E-03 | 3.5E-14 | 1.9E-14 | 5.4E-14 |
| Tetrachloroethene (PCE) | 0.00187224 | 1.00 | 3.3E-12 | 0.10 | 1.7E-12 | 5.1E-02 | 1.7E-13 | 8.8E-14 | 2.5E-13 |
| 2-Methylphenol (o-Cresol) | 0.0060515 | | | | | ND | | | |
| Benzo(a)Anthracene | 0.97406979 | 1.00 | 1.7E-09 | 0.20 | 1.8E-09 | 7.3E-01 | 1.2E-09 | 1.3E-09 | 2.6E-09 |
| Benzo(a)Pyrene | 0.71003095 | 1.00 | 1.2E-09 | 0.20 | 1.3E-09 | 7.3E+00 | 9.0E-09 | 9.6E-09 | 1.9E-08 |
| Benzo(b)Fluoranthene | 0.456302246 | 1.00 | 8.0E-10 | 0.20 | 8.4E-10 | 7.3E-01 | 5.8E-10 | 6.2E-10 | 1.2E-09 |
| Benzo(k)Fluoranthene | 0.5212271 | 1.00 | 9.1E-10 | 0.20 | 9.6E-10 | 7.3E-02 | 6.6E-11 | 7.0E-11 | 1.4E-10 |
| Butylbenzylphthalate | 0.193246212 | | | | | ND | | | |
| Chrysene | 1.095360584 | 1.00 | 1.9E-09 | 0.20 | 2.0E-09 | 7.3E-03 | 1.4E-11 | 1.5E-11 | 2.9E-11 |
| Indeno (1,2,3-cd)Pyrene | 0.25962265 | 1.00 | 4.5E-10 | 0.20 | 4.8E-10 | 7.3E-01 | 3.3E-10 | 3.5E-10 | 6.8E-10 |
| N-Nitrosodiphenylamine | 1.051156552 | 0.91 | 1.7E-09 | 0.17 | 1.7E-09 | 4.9E-03 | 8.2E-12 | 8.1E-12 | 1.6E-11 |
| bis(2-EthylHexyl)phthalate | 37.72849104 | 1.00 | 6.6E-08 | 0.02 | 7.0E-09 | 1.4E-02 | 9.2E-10 | 9.8E-11 | 1.0E-09 |
| 4,4'-DDD | 0.013510286 | 1.00 | 2.4E-11 | 0.20 | 2.5E-11 | 2.4E-01 | 5.7E-12 | 6.0E-12 | 1.2E-11 |
| 4,4'-DDE | 0.01495768 | 1.00 | 2.6E-11 | 0.20 | 2.8E-11 | 3.4E-01 | 8.9E-12 | 9.4E-12 | 1.8E-11 |
| 4,4'-DDT | 0.096925784 | 1.00 | 1.7E-10 | 0.20 | 1.8E-10 | 3.4E-01 | 5.7E-11 | 6.1E-11 | 1.2E-10 |
| Aldrin | 0.00081635 | 1.00 | 1.4E-12 | 0.25 | 1.9E-12 | 1.7E+01 | 2.4E-11 | 3.2E-11 | 5.6E-11 |
| Alpha-BHC | 0.001541392 | 0.96 | 2.6E-12 | 0.18 | 2.5E-12 | 6.3E+00 | 1.6E-11 | 1.6E-11 | 3.2E-11 |
| Alpha-Chlordane | 0.001231571 | 1.00 | 2.1E-12 | 0.05 | 5.7E-13 | 1.3E+00 | 2.8E-12 | 7.4E-13 | 3.5E-12 |
| Dieldrin | 0.000780928 | 1.00 | 1.4E-12 | 0.25 | 1.8E-12 | 1.6E+01 | 2.2E-11 | 2.9E-11 | 5.1E-11 |
| Gamma-BHC (Lindane) | 0.007240963 | 1.00 | 1.3E-11 | 0.20 | 1.3E-11 | 1.3E+00 | 1.6E-11 | 1.7E-11 | 3.4E-11 |
| Gamma-Chlordane | 0.001274346 | 1.00 | 2.2E-12 | 0.05 | 5.9E-13 | 1.3E+00 | 2.9E-12 | 7.7E-13 | 3.7E-12 |
| Heptachlor | 0.000056654 | 1.00 | 9.9E-14 | 0.20 | 1.0E-13 | 4.5E+00 | 4.4E-13 | 4.7E-13 | 9.2E-13 |
| Heptachlor Epoxide | 0.0001206 | 1.00 | 2.1E-13 | 0.20 | 2.2E-13 | 9.1E+00 | 1.9E-12 | 2.0E-12 | 3.9E-12 |
| PCB-1016 | 0.0156408 | 0.85 | 2.3E-11 | 0.07 | 1.0E-11 | 2.0E+00 | 4.6E-11 | 2.0E-11 | 6.7E-11 |
| Arsenic | 9.554368578 | 1.00 | 1.7E-08 | 0.03 | 2.6E-09 | 1.5E+00 | 2.5E-08 | 4.0E-09 | 2.9E-08 |
| Beryllium | 0.037884618 | 1.00 | 6.6E-11 | 0.03 | 1.1E-11 | 4.3E+00 | 2.8E-10 | 4.5E-11 | 3.3E-10 |
| Cadmium | 0.4091042 | | | | | ND | | | |
| Lead | 44.89659863 | | | | | ND | | | |
| | | | | | SUMMARY CANCER RISK | | 4E-08 | 1E-08 | 5E-08 |

[1] MADEP. 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
ND = no data available

CWSSIDAL
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SURFACE SOIL - ENTIRE SITE (EXLUDING SULFATE LANDFILL)
RECEPTOR: CONSTRUCTION (EXCAVATION) WORKER - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-9

09-Jun-97

NONCARCINOGENIC EFFECTS

| COMPOUND | SOIL CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | SUBCHRONIC RfD (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|
| 1,1,1-Trichloroethane | 0.006324323 | 1.00 | 5.0E-09 | 0.10 | 2.6E-09 | 9.0E-02 | 5.5E-08 | 2.9E-08 | 8.4E-08 |
| 1,1-Dichloroethene | 0.0009804 | 1.00 | 7.7E-10 | 0.10 | 4.1E-10 | 9.0E-03 | 8.5E-08 | 4.5E-08 | 1.3E-07 |
| 2,4,4-Trimethyl-1-pentene | 0.00053105 | 0.99 | 4.1E-10 | 0.11 | 2.4E-10 | 2.1E-01 | 2.0E-09 | 1.2E-09 | 3.2E-09 |
| 2-Butanone (MEK) | 0.000517312 | 1.00 | 4.0E-10 | 0.10 | 2.1E-10 | 2.0E+00 | 2.0E-10 | 1.1E-10 | 3.1E-10 |
| Acetone | 0.007891954 | 1.00 | 6.2E-09 | 0.10 | 3.3E-09 | 1.0E+00 | 6.2E-09 | 3.3E-09 | 9.5E-09 |
| Methylene Chloride | 0.002680076 | 1.00 | 2.1E-09 | 0.10 | 1.1E-09 | 6 0E-02 | 3.5E-08 | 1.9E-08 | 5.4E-08 |
| Tetrachloroethene (PCE) | 0.00187224 | 1.00 | 1.5E-09 | 0.10 | 7.8E-10 | 1 0E-01 | 1.5E-08 | 7.8E-09 | 2.2E-08 |
| Toluene | 0.003269972 | 1.00 | 2.6E-09 | 0.12 | 1.6E-09 | 2.0E+00 | 1.3E-09 | 8.1E-10 | 2.1E-09 |
| 2-Methylnaphthalene | 3.38426955 | 1.00 | 2.6E-06 | 0.20 | 2.8E-06 | 3.0E-02 | 8.8E-05 | 9.4E-05 | 1.8E-04 |
| 2-Methylphenol (o-Cresol) | 0.0060515 | 1.00 | 4.7E-09 | 0.19 | 4.7E-09 | 5.0E-01 | 9.5E-09 | 9.4E-09 | 1.9E-08 |
| Acenaphthene | 1.04778635 | 1.00 | 8.2E-07 | 0.20 | 8.7E-07 | 6.0E-01 | 1.4E-06 | 1.5E-06 | 2.8E-06 |
| Acenaphthylene | 2.559277806 | 0.91 | 1.8E-06 | 0.18 | 1.9E-06 | 3.0E-02 | 6.1E-05 | 6.4E-05 | 1.2E-04 |
| Anthracene | 1.785742086 | 1.00 | 1.4E-06 | 0.29 | 2.2E-06 | 3 0E+00 | 4.7E-07 | 7.2E-07 | 1.2E-06 |
| Benzo(a)Anthracene | 0.97406979 | 0.91 | 6.9E-07 | 0.18 | 7.3E-07 | 3 0E-02 | 2.3E-05 | 2.4E-05 | 4.7E-05 |
| Benzo(a)Pyrene | 0.71003095 | 0.91 | 5.1E-07 | 0.18 | 5.3E-07 | 3 0E-02 | 1.7E-05 | 1.8E-05 | 3.5E-05 |
| Benzo(b)Fluoranthene | 0.456302246 | 0.91 | 3.3E-07 | 0.18 | 3.4E-07 | 3.0E-02 | 1.1E-05 | 1.1E-05 | 2.2E-05 |
| Benzo(g,h,i)Perylene | 0.28812645 | 0.91 | 2.1E-07 | 0.18 | 2.2E-07 | 3.0E-02 | 6.8E-06 | 7.2E-06 | 1.4E-05 |
| Benzo(k)Fluoranthene | 0.5212271 | 0.91 | 3.7E-07 | 0.18 | 3.9E-07 | 3 0E-02 | 1.2E-05 | 1.3E-05 | 2.5E-05 |
| Benzoic Acid | 0.404715488 | 0.96 | 3.0E-07 | 0.18 | 3.0E-07 | 4.0E+00 | 7.6E-08 | 7.5E-08 | 1.5E-07 |
| Butylbenzylphthalate | 0.193246212 | 0.96 | 1.4E-07 | 0.18 | 1.4E-07 | 2.0E+00 | 7.2E-08 | 7.2E-08 | 1.4E-07 |
| Chrysene | 1.095360584 | 0.91 | 7.8E-07 | 0.18 | 8.2E-07 | 3.0E-02 | 2.6E-05 | 2.7E-05 | 5.3E-05 |
| Di-n-butylphthalate | 0.279702126 | 0.96 | 2.1E-07 | 0.18 | 2.1E-07 | 1.0E+00 | 2.1E-07 | 2.1E-07 | 4.2E-07 |
| Di-n-octylphthalate | 0.082199416 | 0.96 | 6.2E-08 | 0.18 | 6.1E-08 | 2.0E-02 | 3.1E-06 | 3.1E-06 | 6.1E-06 |
| Dibenzofuran | 0.277474248 | 1.00 | 2.2E-07 | 0.19 | 2.2E-07 | 3.0E-02 | 7.2E-06 | 7.2E-06 | 1.4E-05 |
| Diethylphthalate | 0.038086766 | 1.00 | 3.0E-08 | 0.02 | 3.2E-09 | 8.0E+00 | 3.7E-09 | 4.0E-10 | 4.1E-09 |
| Fluoranthene | 2.677110124 | 1.00 | 2.1E-06 | 0.20 | 2.2E-06 | 4.0E-01 | 5.2E-06 | 5.6E-06 | 1.1E-05 |
| Fluorene | 2.57569671 | 1.00 | 2.0E-06 | 0.20 | 2.1E-06 | 4.0E-01 | 5.0E-06 | 5.3E-06 | 1.0E-05 |
| Indeno (1,2,3-cd)Pyrene | 0.25962265 | 0.91 | 1.8E-07 | 0.18 | 1.9E-07 | 3 0E-02 | 6.2E-06 | 6.5E-06 | 1.3E-05 |
| N-Nitrosodiphenylamine | 1.031156552 | 0.96 | 7.9E-07 | 0.18 | 7.8E-07 | 5 0E-02 | 1.6E-05 | 1.6E-05 | 3.1E-05 |
| Naphthalene | 3.356851364 | 1.00 | 2.6E-06 | 0.10 | 1.4E-06 | 4 0E-02 | 6.6E-05 | 3.5E-05 | 1.0E-04 |
| Phenanthrene | 6.362283244 | 0.91 | 4.5E-06 | 0.18 | 4.8E-06 | 3.0E-02 | 1.5E-04 | 1.6E-04 | 3.1E-04 |
| Phenol | 0.337041 | 1.00 | 2.6E-07 | 0.26 | 3.6E-07 | 6.0E-01 | 4.4E-07 | 6.1E-07 | 1.0E-06 |

CWSSIDAL
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SURFACE SOIL - ENTIRE SITE (EXLUDING SULFATE LANDFILL)
RECEPTOR: CONSTRUCTION (EXCAVATION) WORKER - FUTURE LAND USE
OLIN CORPORATION
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TABLE A6-9

09-Jun-97

NONCARCINOGENIC EFFECTS

| COMPOUND | SOIL CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | SUBCHRONIC RfD (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|
| Pyrene | 2.174239158 | 1.00 | 1.7E-06 | 0.20 | 1.8E-06 | 3.0E-01 | 5.7E-06 | 6.0E-06 | 1.2E-05 |
| bis(2-Ethyl Hexyl)phthalate | 37.72849104 | 1.00 | 3.0E-05 | 0.02 | 3.1E-06 | 2.0E-02 | 1.5E-03 | 1.6E-04 | 1.6E-03 |
| 4,4'-DDD | 0.013510286 | 0.96 | 1.0E-08 | 0.18 | 1.0E-08 | 5 0E-04 | 2.0E-05 | 2.0E-05 | 4.0E-05 |
| 4,4'-DDE | 0.01495768 | 0.96 | 1.1E-08 | 0.18 | 1.1E-08 | 5.0E-04 | 2.2E-05 | 2.2E-05 | 4.5E-05 |
| 4,4'-DDT | 0.096925784 | 0.96 | 7.3E-08 | 0.18 | 7.2E-08 | 5.0E-04 | 1.5E-04 | 1.4E-04 | 2.9E-04 |
| Aldrin | 0.00081635 | 1.00 | 6.4E-10 | 0.25 | 8.5E-10 | 3.0E-05 | 2.1E-05 | 2.8E-05 | 5.0E-05 |
| Alpha-BHC | 0.001541392 | 0.96 | 1.2E-09 | 0.18 | 1.1E-09 | 5.0E-04 | 2.3E-06 | 2.3E-06 | 4.6E-06 |
| Alpha-Chlordane | 0.001231571 | 1.00 | 9.6E-10 | 0.05 | 2.6E-10 | 6.0E-05 | 1.6E-05 | 4.3E-06 | 2.0E-05 |
| Dieldrin | 0.000780928 | 1.00 | 6.1E-10 | 0.25 | 8.1E-10 | 5.0E-05 | 1.2E-05 | 1.6E-05 | 2.8E-05 |
| Endosulfan I | 0.001311112 | 0.96 | 9.8E-10 | 0.18 | 9.7E-10 | 6.0E-03 | 1.6E-07 | 1.6E-07 | 3.3E-07 |
| Endosulfan II | 0.00353234 | 0.96 | 2.6E-09 | 0.18 | 2.6E-09 | 6.0E-03 | 4.4E-07 | 4.4E-07 | 8.8E-07 |
| Endrin | 0.001643931 | 1.00 | 1.3E-09 | 0.25 | 1.7E-09 | 3.0E-04 | 4.3E-06 | 5.7E-06 | 1.0E-05 |
| Endrin Ketone | 0.000729454 | 0.96 | 5.5E-10 | 0.18 | 5.4E-10 | 3.0E-04 | 1.8E-06 | 1.8E-06 | 3.6E-06 |
| Gamma-BHC (Lindane) | 0.007240963 | 1.00 | 5.7E-09 | 0.20 | 6.0E-09 | 3.0E-03 | 1.9E-06 | 2.0E-06 | 3.9E-06 |
| Gamma-Chlordane | 0.001274346 | 1.00 | 1.0E-09 | 0.05 | 2.6E-10 | 6 0E-05 | 1.7E-05 | 4.4E-06 | 2.1E-05 |
| Heptachlor | 0.000056654 | 1.00 | 4.4E-11 | 0.20 | 4.7E-11 | 5 0E-04 | 8.9E-08 | 9.4E-08 | 1.8E-07 |
| Heptachlor Epoxide | 0.0001206 | 1.00 | 9.4E-11 | 0.20 | 1.0E-10 | 1 3E-05 | 7.3E-06 | 7.7E-06 | 1.5E-05 |
| PCB-1016 | 0.0156408 | 0.96 | 1.2E-08 | 0.18 | 1.2E-08 | 7.0E-05 | 1.7E-04 | 1.7E-04 | 3.3E-04 |
| Aluminum | 5693.433555 | | | | | | | | |
| Antimony | 1.696626612 | 1.00 | 1.3E-06 | 0.10 | 7.0E-07 | 4 0E-04 | 3.3E-03 | 1.8E-03 | 5.1E-03 |
| Arsenic | 9.554368578 | 1.00 | 7.5E-06 | 0.03 | 1.2E-06 | 3.0E-04 | 2.5E-02 | 4.0E-03 | 2.9E-02 |
| Barium | 21.64126823 | 0.71 | 1.2E-05 | 0.05 | 4.9E-06 | 7.0E-02 | 1.7E-04 | 7.0E-05 | 2.4E-04 |
| Beryllium | 0.037884618 | 1.00 | 3.0E-08 | 0.03 | 4.7E-09 | 5.0E-03 | 5.9E-06 | 9.4E-07 | 6.9E-06 |
| Cadmium | 0.4091042 | 1.00 | 3.2E-07 | 0.14 | 2.4E-07 | 5.0E-04 | 6.4E-04 | 4.8E-04 | 1.1E-03 |
| Calcium | 2380.75896 | | | | | | | | |
| Chromium III | 146.259461 | 1.00 | 1.1E-04 | 0.04 | 2.4E-05 | 1.0E+00 | 1.1E-04 | 2.4E-05 | 1.4E-04 |
| Chromium VI | 16.25105122 | 1.00 | 1.3E-05 | 0.09 | 6.1E-06 | 2.0E-02 | 6.4E-04 | 3.0E-04 | 9.4E-04 |
| Cobalt | 3.020114384 | 1.86 | 4.4E-06 | 0.14 | 1.8E-06 | 6.0E-02 | 7.3E-05 | 3.0E-05 | 1.0E-04 |
| Cyanide | 0.202692 | 1.00 | 1.6E-07 | 0.30 | 2.5E-07 | 2.0E-02 | 7.9E-06 | 1.3E-05 | 2.1E-05 |
| Iron | 8533.955256 | | | | | | | | |
| Lead | 44.89659863 | 0.50 | 1.8E-05 | 0.01 | 1.1E-06 | 7.5E-04 | 2.3E-02 | 1.5E-03 | 2.5E-02 |
| Manganese | 86.62145349 | 1.86 | 1.3E-04 | 0.14 | 5.1E-05 | 4.7E-02 | 2.7E-03 | 1.1E-03 | 3.8E-03 |
| Mercury | 0.128231552 | 1.00 | 1.0E-07 | 0.05 | 2.7E-08 | 3.0E-04 | 3.3E-04 | 8.9E-05 | 4.2E-04 |
| Nickel | 8.0484322 | 1.00 | 6.3E-06 | 0.35 | 1.2E-05 | 2.0E-02 | 3.2E-04 | 5.8E-04 | 9.0E-04 |
| Selenium | 0.633355458 | 1.00 | 5.0E-07 | 0.00 | 5.3E-09 | 5.0E-03 | 9.9E-05 | 1.1E-06 | 1.0E-04 |
| Sodium | 67.04148273 | | | | | | | | |
| Thallium | 0.546068228 | 1.00 | 4.3E-07 | 0.01 | 2.3E-08 | 8.0E-04 | 5.3E-04 | 2.8E-05 | 5.6E-04 |
| Vanadium | 17.53779468 | 0.71 | 9.7E-06 | 0.05 | 4.0E-06 | 7.0E-03 | 1.4E-03 | 5.7E-04 | 2.0E-03 |
| Zinc | 43.38254963 | 1.00 | 3.4E-05 | 0.02 | 3.6E-06 | 3.0E-01 | 1.1E-04 | 1.2E-05 | 1.3E-04 |
| Chloride | 54.3014319 | | | | | | | | |
| Nitrogen, Ammonia | 78.05334668 | 0.71 | 4.3E-05 | 0.05 | 1.8E-05 | 3.7E-01 | 1.2E-04 | 4.8E-05 | 1.6E-04 |
| Sulfate as SO4 | 1898.499298 | | | | | | | | |
| SUMMARY HAZARD INDEX | | | | | | | 6E-02 | 1E-02 | 7E-02 |

CWSSINAL
INHALATION EXPOSURE TO OHM IN SURFACE SOIL PARTICULATES - ENTIRE SITE (EXCLUDING SULFATE LANDFILL)
RECEPTOR: CONSTRUCTION (EXCAVATION ) WORKER - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-10

09-Jun-97

EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| CONCENTRATION IN AIR | [RP]air | 60 | ug/m3 | MADEP, 1995 |
| CONCENTRATION IN SOIL | [OHM]part | chemical-specific | mg/kg | |
| CONVERSION FACTOR 1 | CF1 | 24 | hours/day | |
| EXPOSURE TIME DAILY | ET | 8 | hours/day | Assumption |
| EXPOSURE FREQUENCY (1) | EF | 40 | days/year | Assumption |
| EXPOSURE DURATION (1) | ED | 0.167 | years | Assumption |
| CONVERSION FACTOR 2 | CF2 | 365 | days/year | |
| CONVERSION FACTOR 3 | CF3 | 0.000001 | kg/mg | |
| AVERAGING TIME CANCER | AT | 75 | years | MADEP, 1995 |
| AVERAGING TIME NONCANCER | AT | 0.167 | years | Assumption |

(1) 5 days per week for 2 months.
MADEP, 1995. Guidance for Disposal Site Risk Characterization, Interim Final Policy WSC/ORS-95-141. July.

EQUATIONS

CANCER RISK = AVG. CONC. (ug/m3) * CANCER UNIT RISK (ug/m3)^-1

HAZARD QUOTIENT = AVG.CONC.(ug/m3)/REF. CONC. (ug/m3)

$$\text{AVG. EXPOSURE CONC.} = \frac{[\text{OHM}]\text{air} * \text{EF} * \text{ET} * \text{ED}}{\text{AT} * \text{CF1} * \text{CF2}}$$

OHM AIR CONC. = [RP]air * [OHM]part * CF3

Note:
*For noncarcinogenic effects: AT = ED

CWSSINAL
INHALATION EXPOSURE TO OHM IN SURFACE SOIL PARTICULATES - ENTIRE SITE (EXCLUDING SULFATE LANDFILL)
RECEPTOR: CONSTRUCTION (EXCAVATION ) WORKER - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-10

09-Jun-97

CARCINOGENIC EFFECTS

| COMPOUND | OHM SOIL CONCENTRATION (mg/kg) | OHM AIR CONCENTRATION (ug/m³) | AVERAGE AIR CONCENTRATION LIFETIME (ug/m3) | INHALATION CANCER UNIT RISK (ug/m3)^-1 | CANCER RISK |
|---|---|---|---|---|---|
| 1,1-Dichloroethene | 0.0009804 | 5.8824E-08 | 4.8E-12 | 5.0E-05 | 2.4E-16 |
| Methylene Chloride | 0.002680076 | 1.60805E-07 | 1.3E-11 | 4.7E-07 | 6.1E-18 |
| Tetrachloroethene (PCE) | 0.00187224 | 1.12334E-07 | 9.1E-12 | 5.9E-06 | 5.4E-17 |
| 2-Methylphenol (o-Cresol) | 0.0060515 | 3.6309E-07 | 3.0E-11 | ND | |
| Benzo(a)Anthracene | 0.97406979 | 5.84442E-05 | 4.8E-09 | 1.1E-04 | 5.2E-13 |
| Benzo(a)Pyrene | 0.71003095 | 4.26019E-05 | 3.5E-09 | 1.1E-03 | 3.8E-12 |
| Benzo(b)Fluoranthene | 0.456302246 | 2.73781E-05 | 2.2E-09 | 1.1E-04 | 2.4E-13 |
| Benzo(k)Fluoranthene | 0.5212271 | 3.12736E-05 | 2.5E-09 | 1.1E-05 | 2.8E-14 |
| Butylbenzylphthalate | 0.193246212 | 1.15948E-05 | 9.4E-10 | ND | |
| Chrysene | 1.095360584 | 6.57216E-05 | 5.3E-09 | 1.1E-06 | 5.9E-15 |
| Indeno (1,2,3-cd)Pyrene | 0.25962265 | 1.55774E-05 | 1.3E-09 | 1.1E-04 | 1.4E-13 |
| N-Nitrosodiphenylamine | 1.051156552 | 6.30694E-05 | 5.1E-09 | 2.6E-06 | 1.3E-14 |
| bis(2-EthylHexyl)phthalate | 37.72849104 | 0.002263709 | 1.8E-07 | 2.4E-06 | 4.4E-13 |
| 4,4'-DDD | 0.013510286 | 8.10617E-07 | 6.6E-11 | 9.7E-05 | 6.4E-15 |
| 4,4'-DDE | 0.01495768 | 8.97461E-07 | 7.3E-11 | 9.7E-05 | 7.1E-15 |
| 4,4'-DDT | 0.096925784 | 5.81555E-06 | 4.7E-10 | 9.7E-05 | 4.6E-14 |
| Aldrin | 0.00081635 | 4.8981E-08 | 4.0E-12 | 4.9E-03 | 2.0E-14 |
| Alpha-BHC | 0.001541392 | 9.24835E-08 | 7.5E-12 | 1.8E-03 | 1.4E-14 |
| Alpha-Chlordane | 0.001231571 | 7.38942E-08 | 6.0E-12 | 3.7E-04 | 2.2E-15 |
| Dieldrin | 0.000780928 | 4.68557E-08 | 3.8E-12 | 4.6E-03 | 1.8E-14 |
| Gamma-BHC (Lindane) | 0.007240963 | 4.34458E-07 | 3.5E-11 | 1.8E-05 | 6.5E-16 |
| Gamma-Chlordane | 0.001274346 | 7.64607E-08 | 6.2E-12 | 3.7E-04 | 2.3E-15 |
| Heptachlor | 0.000056654 | 3.39924E-09 | 2.8E-13 | 1.3E-03 | 3.6E-16 |
| Heptachlor Epoxide | 0.0001206 | 7.236E-09 | 5.9E-13 | 2.6E-03 | 1.5E-15 |
| PCB-1016 | 0.0156408 | 9.38448E-07 | 7.6E-11 | ND | |
| Arsenic | 9.554368578 | 0.000573262 | 4.7E-08 | 4.3E-03 | 2.0E-10 |
| Beryllium | 0.037884618 | 2.27308E-06 | 1.8E-10 | 2.4E-03 | 4.4E-13 |
| Cadmium | 0.4091042 | 2.45463E-05 | 2.0E-09 | 1.8E-03 | 3.6E-12 |
| Chromium VI | 16.25105122 | 0.000975063 | 7.9E-08 | 1.2E-02 | 9.5E-10 |
| Lead | 44.89659863 | 0.002693796 | 2.2E-07 | ND | |
| Nickel | 8.0484322 | 0.000482906 | 3.9E-08 | 2.4E-04 | 9.4E-12 |
| | | | SUMMARY CANCER RISK | | 1E-09 |

ND = No data available.

CWSSINAL
INHALATION EXPOSURE TO OHM IN SURFACE SOIL PARTICULATES - ENTIRE SITE (EXCLUDING SULFATE LANDFILL)
RECEPTOR: CONSTRUCTION (EXCAVATION ) WORKER - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-10

09-Jun-97

NONCARCINOGENIC EFFECTS

| COMPOUND | OHM SOIL CONCENTRATION mg/kg | OHM AIR CONCENTRATION (ug/m3) | AVERAGE AIR CONCENTRATION FOR TIME PERIOD (ug/m3) | SUBCHRONIC INHALATION RfC [1] (ug/m3) | HAZARD QUOTIENT |
|---|---|---|---|---|---|
| 1,1,1-Trichloroethane | 0.006324323 | 3.79459E-07 | 1.4E-08 | 1000 | 1.4E-11 |
| 1,1-Dichloroethene | 0.0009804 | 5.8824E-08 | 2.1E-09 | 50 | 4.3E-11 |
| 2,4,4-Trimethyl-1-pentene | 0.00053105 | 3.1863E-08 | 1.2E-09 | 717.5 | 1.6E-12 |
| 2-Butanone (MEK) | 0.000517312 | 3.10387E-08 | 1.1E-09 | 1000 | 1.1E-12 |
| Acetone | 0.007891954 | 4.73517E-07 | 1.7E-08 | 800 | 2.2E-11 |
| Methylene Chloride | 0.002680076 | 1.60805E-07 | 5.9E-09 | 3000 | 2.0E-12 |
| Tetrachloroethene (PCE) | 0.00187224 | 1.12334E-07 | 4.1E-09 | 4600 | 8.9E-13 |
| Toluene | 0.003269972 | 1.96198E-07 | 7.2E-09 | 400 | 1.8E-11 |
| 2-Methylnaphthalene | 3.38426955 | 0.000203056 | 7.4E-06 | 71 | 1.0E-07 |
| 2-Methylphenol (o-Cresol) | 0.0060515 | 3.6309E-07 | 1.3E-08 | 100 | 1.3E-10 |
| Acenaphthene | 1.04778635 | 6.28672E-05 | 2.3E-06 | 71 | 3.2E-08 |
| Acenaphthylene | 2.559277806 | 0.000153557 | 5.6E-06 | 71 | 7.9E-08 |
| Anthracene | 1.785742086 | 0.000107145 | 3.9E-06 | 71 | 5.5E-08 |
| Benzo(a)Anthracene | 0.97406979 | 5.84442E-05 | 2.1E-06 | 71 | 3.0E-08 |
| Benzo(a)Pyrene | 0.71003095 | 4.26019E-05 | 1.6E-06 | 71 | 2.2E-08 |
| Benzo(b)Fluoranthene | 0.456302246 | 2.73781E-05 | 1.0E-06 | 71 | 1.4E-08 |
| Benzo(g,h,i)Perylene | 0.28812645 | 1.72876E-05 | 6.3E-07 | 71 | 8.9E-09 |
| Benzo(k)Fluoranthene | 0.5212271 | 3.12736E-05 | 1.1E-06 | 71 | 1.6E-08 |
| Benzoic Acid | 0.404715488 | 2.42829E-05 | 8.9E-07 | | |
| Butylbenzylphthalate | 0.193246212 | 1.15948E-05 | 4.2E-07 | 7 | 6.1E-08 |
| Chrysene | 1.095360584 | 6.57216E-05 | 2.4E-06 | 71 | 3.4E-08 |
| Di-n-butylphthalate | 0.279702126 | 1.67821E-05 | 6.1E-07 | 7 | 8.8E-08 |
| Di-n-octylphthalate | 0.082199416 | 4.93196E-06 | 1.8E-07 | 7 | 2.6E-08 |
| Dibenzofuran | 0.277474248 | 1.66485E-05 | 6.1E-07 | | |
| Diethylphthalate | 0.038086766 | 2.28521E-06 | 8.3E-08 | 7 | 1.2E-08 |
| Fluoranthene | 2.677110124 | 0.000160627 | 5.9E-06 | 71 | 8.3E-08 |
| Fluorene | 2.57569671 | 0.000154542 | 5.6E-06 | 71 | 8.0E-08 |
| Indeno (1,2,3-cd)Pyrene | 0.25962265 | 1.55774E-05 | 5.7E-07 | 71 | 8.0E-09 |
| N-Nitrosodiphenylamine | 1.051156552 | 6.30694E-05 | 2.3E-06 | | |
| Naphthalene | 3.356851364 | 0.000201411 | 7.4E-06 | 71 | 1.0E-07 |
| Phenanthrene | 6.362283244 | 0.000381737 | 1.4E-05 | 71 | 2.0E-07 |
| Phenol | 0.337041 | 2.02225E-05 | 7.4E-07 | 260 | 2.8E-09 |
| Pyrene | 2.174239158 | 0.000130454 | 4.8E-06 | 71 | 6.7E-08 |
| bis(2-EthylHexyl)phthalate | 37.72849104 | 0.002263709 | 8.3E-05 | 7 | 1.2E-05 |
| 4,4'-DDD | 0.013510286 | 8.10617E-07 | 3.0E-08 | | |
| 4,4'-DDE | 0.01495768 | 8.97461E-07 | 3.3E-08 | | |
| 4,4'-DDT | 0.096925784 | 5.81555E-06 | 2.1E-07 | | |

CWSSINAL
INHALATION EXPOSURE TO OHM IN SURFACE SOIL PARTICULATES - ENTIRE SITE (EXCLUDING SULFATE LANDFILL)
RECEPTOR: CONSTRUCTION (EXCAVATION ) WORKER - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-10

09-Jun-97
NONCARCINOGENIC EFFECTS

| COMPOUND | OHM SOIL CONCENTRATION mg/kg | OHM AIR CONCENTRATION (mg/m3) | AVERAGE AIR CONCENTRATION FOR TIME PERIOD (mg/m3) | SUBCHRONIC INHALATION RfC [1] (mg/m3) | HAZARD QUOTIENT |
|---|---|---|---|---|---|
| Aldrin | 0.00081635 | 4.8981E-08 | 1.8E-09 | | |
| Alpha-BHC | 0.001541392 | 9.24835E-08 | 3.4E-09 | 0.7 | 4.8E-09 |
| Alpha-Chlordane | 0.001231571 | 7.38942E-08 | 2.7E-09 | 0.7 | 3.9E-09 |
| Dieldrin | 0.000780928 | 4.68557E-08 | 1.7E-09 | | |
| Endosulfan I | 0.001311112 | 7.86667E-08 | 2.9E-09 | | |
| Endosulfan II | 0.00353234 | 2.1194E-07 | 7.7E-09 | | |
| Endrin | 0.001643931 | 9.86359E-08 | 3.6E-09 | | |
| Endrin Ketone | 0.000729454 | 4.37672E-08 | 1.6E-09 | | |
| Gamma-BHC (Lindane) | 0.007240963 | 4.34458E-07 | 1.6E-08 | 0.7 | 2.3E-08 |
| Gamma-Chlordane | 0.001274346 | 7.64607E-08 | 2.8E-09 | 0.7 | 4.0E-09 |
| Heptachlor | 0.000056654 | 3.39924E-09 | 1.2E-10 | 0.7 | 1.8E-10 |
| Heptachlor Epoxide | 0.0001206 | 7.236E-09 | 2.6E-10 | 0.7 | 3.8E-10 |
| PCB-1016 | 0.0156408 | 9.38448E-07 | 3.4E-08 | 0.02 | 1.7E-06 |
| Aluminum | 5693.433555 | 0.341606013 | 1.2E-02 | | |
| Antimony | 1.696626612 | 0.000101798 | 3.7E-06 | 10 | 3.7E-07 |
| Arsenic | 9.554368578 | 0.000573262 | 2.1E-05 | 0.0025 | 8.4E-03 |
| Barium | 21.64126823 | 0.001298476 | 4.7E-05 | 5 | 9.5E-06 |
| Beryllium | 0.037884618 | 2.27308E-06 | 8.3E-08 | 0.005 | 1.7E-05 |
| Cadmium | 0.4091042 | 2.45463E-05 | 9.0E-07 | 0.2 | 4.5E-06 |
| Calcium | 2380.75896 | 0.142845538 | 5.2E-03 | | |
| Chromium III | 146.259461 | 0.008775568 | 3.2E-04 | 6.8 | 4.7E-05 |
| Chromium VI | 16.25105122 | 0.000975063 | 3.6E-05 | 0.02 | 1.8E-03 |
| Cobalt | 3.020114384 | 0.000181207 | 6.6E-06 | | |
| Cyanide | 0.202692 | 1.21615E-05 | 4.4E-07 | 7 | 6.3E-08 |
| Iron | 8533.955256 | 0.512037315 | 1.9E-02 | | |
| Lead | 44.89659863 | 0.002693796 | 9.8E-05 | 0.7 | 1.4E-04 |
| Manganese | 86.62145349 | 0.005197287 | 1.9E-04 | 0.05 | 3.8E-03 |
| Mercury | 0.128231552 | 7.69389E-06 | 2.8E-07 | 0.3 | 9.4E-07 |
| Nickel | 8.0484322 | 0.000482906 | 1.8E-05 | 0.009 | 2.0E-03 |
| Selenium | 0.633355458 | 3.80013E-05 | 1.4E-06 | 2.7 | 5.1E-07 |
| Sodium | 67.04148273 | 0.004022489 | 1.5E-04 | | |
| Thallium | 0.546068228 | 3.27641E-05 | 1.2E-06 | | |
| Vanadium | 17.53779468 | 0.001052268 | 3.8E-05 | 6 | 6.4E-06 |
| Zinc | 43.38254963 | 0.002602953 | 9.5E-05 | | |
| Chloride | 54.3014319 | 0.003258086 | 1.2E-04 | | |
| Nitrogen, Ammonia | 78.05334668 | 0.004683201 | 1.7E-04 | 100 | 1.7E-06 |
| Sulfate as SO4 | 1898.499298 | 0.113909958 | 4.2E-03 | | |
| | | | SUMMARY HAZARD INDEX | | 2E-02 |

ND = No data available.

MWSIDSLF
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SURFACE SOIL - SULFATE LANDFILL
RECEPTOR: FULL-TIME, LONG-TERM ON-SITE WORKER (PLANT B AREA AND MAINTENANCE ) - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-11

18-Jun-97

EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| CONCENTRATION SOIL | [OHM]soil | chemical specific | chemical-specific | |
| INGESTION RATE | IR | 50 | mg-soil/day | MADEP, 1995 |
| ADHERENCE FACTOR | AF | 0.51 | mg-soil/cm²-skin | MADEP, 1995 |
| AVERAGE SURFACE AREA (1) | SA | 5,200 | cm²/day | calculated per MADEP, 1995 |
| RELATIVE ABSORPTION FACTOR-ORAL | RAF-O | chemical specific | unitless | MADEP, 1994, 1995 |
| RELATIVE ABSORPTION FACTOR -DERM | RAF-D | chemical specific | unitless | MADEP, 1994, 1995 |
| CONVERSION FACTOR | CF | 1.00E-06 | kg/mg | |
| BODY WEIGHT | BW | 70 | kg | USEPA, 1989 |
| EXPOSURE PERIOD | EP | 25 | years | USEPA, 1991 |
| EXPOSURE FREQUENCY (2) | EF | 153 | events/year | Assumption |
| EXPOSURE DURATION (2) | ED | 1 | day/event | Assumption |
| AVERAGING PERIOD | | | | |
| CANCER | AP | 75 | years | MADEP, 1995 |
| NONCANCER | AP | 25 | years | USEPA, 1991 |

(1) 50th percentile of surface areas for males: head, hands, arms.
(2) Values for residential exposure frequency used as a conservative estimate of outdoor worker exposure.

MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
MADEP, 1995. Guidance for Disposal Site Risk Characterization. Interim Final Policy WSC/ORS-95-141. July 1995.
USEPA, 1989. Exposure Factors Handbook. EPA/600/8-89/043. May 1989.
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors." OSWER Directive 9285.6-03.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)^-1

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE-INGESTION} = \frac{[OHM]soil \times IR \times RAF\text{-}O \times CF \times EF \times ED \times EP}{BW \times AP \times 365 \text{ days/yr}}$$

$$\text{INTAKE-DERMAL} = \frac{[OHM]soil \times SA \times AF \times RAF\text{-}D \times EF \times ED \times EP \times CF}{BW \times AP \times 365 \text{ days/yr}}$$

MWSIDSLF
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SURFACE SOIL - SULFATE LANDFILL
RECEPTOR: FULL-TIME, LONG-TERM ON-SITE WORKER (PLANT B AREA AND MAINTENANCE ) - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-11

18-Jun-97

CARCINOGENIC EFFECTS

| | SOIL CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | CANCER SLOPE FACTOR (mg/kg-day)^-1 | CANCER RISK INGESTION | CANCER RISK DERMAL | TOTAL CANCER RISK |
|---|---|---|---|---|---|---|---|---|---|
| Benzo(a)Anthracene | 0.038 | 1.00 | 3.8E-09 | 0.20 | 4.0E-08 | 7.3E-01 | 2.8E-09 | 2.9E-08 | 3.2E-08 |
| Benzo(a)Pyrene | 0.046 | 1.00 | 4.6E-09 | 0.20 | 4.9E-08 | 7.3E+00 | 3.4E-08 | 3.6E-07 | 3.9E-07 |
| Benzo(b)Fluoranthene | 0.0665 | 1.00 | 6.6E-09 | 0.20 | 7.0E-08 | 7.3E-01 | 4.8E-09 | 5.1E-08 | 5.6E-08 |
| Benzo(k)Fluoranthene | 0.018 | 1.00 | 1.8E-09 | 0.20 | 1.9E-08 | 7.3E-02 | 1.3E-10 | 1.4E-09 | 1.5E-09 |
| Chrysene | 0.0445 | 1.00 | 4.4E-09 | 0.20 | 4.7E-08 | 7.3E-03 | 3.2E-11 | 3.4E-10 | 3.8E-10 |
| Indeno (1,2,3-cd)Pyrene | 0.047 | 1.00 | 4.7E-09 | 0.20 | 5.0E-08 | 7.3E-01 | 3.4E-09 | 3.6E-08 | 4.0E-08 |
| bis(2-EthylHexyl)phthalate | 0.083 | 1.00 | 8.3E-09 | 0.02 | 8.8E-09 | 1.4E-02 | 1.2E-10 | 1.2E-10 | 2.4E-10 |
| Arsenic | 8.0333 | 1.00 | 8.0E-07 | 0.03 | 1.3E-06 | 1.5E+00 | 1.2E-06 | 1.9E-06 | 3.1E-06 |
| Lead | 28.5 | | | | | ND | | | |
| | | | | | SUMMARY CANCER RISK | | 1E-06 | 2E-06 | 4E-06 |

[1] MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
ND = no data available

MWSIDSLF
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SURFACE SOIL - SULFATE LANDFILL
RECEPTOR: FULL-TIME, LONG-TERM ON-SITE WORKER (PLANT B AREA AND MAINTENANCE ) - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-11

18-Jun-97

NONCARCINOGENIC EFFECTS

| COMPOUND | SOIL CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|
| Toluene | 0.003 | 1.00 | 9.0E-10 | 0.12 | 5.7E-09 | 2.0E-01 | 4.5E-09 | 2.9E-08 | 3.3E-08 |
| Benzo(a)Anthracene | 0.038 | 0.91 | 1.0E-08 | 0.18 | 1.1E-07 | 3.0E-02 | 3.5E-07 | 3.6E-06 | 4.0E-06 |
| Benzo(a)Pyrene | 0.046 | 0.91 | 1.3E-08 | 0.18 | 1.3E-07 | 3.0E-02 | 4.2E-07 | 4.4E-06 | 4.8E-06 |
| Benzo(b)Fluoranthene | 0.0665 | 0.91 | 1.8E-08 | 0.18 | 1.9E-07 | 3.0E-02 | 6.0E-07 | 6.3E-06 | 6.9E-06 |
| Benzo(g,h,i)Perylene | 0.029 | 0.91 | 7.9E-09 | 0.18 | 8.3E-08 | 3.0E-02 | 2.6E-07 | 2.8E-06 | 3.0E-06 |
| Benzo(k)Fluoranthene | 0.018 | 0.91 | 4.9E-09 | 0.18 | 5.1E-08 | 3.0E-02 | 1.6E-07 | 1.7E-06 | 1.9E-06 |
| Chrysene | 0.0445 | 0.91 | 1.2E-08 | 0.18 | 1.3E-07 | 3.0E-02 | 4.0E-07 | 4.2E-06 | 4.6E-06 |
| Di-n-butylphthalate | 0.017 | 0.96 | 4.9E-09 | 0.18 | 4.8E-08 | 1.0E-01 | 4.9E-08 | 4.8E-07 | 5.3E-07 |
| Fluoranthene | 0.0825 | 1.00 | 2.5E-08 | 0.20 | 2.6E-07 | 4.0E-02 | 6.2E-07 | 6.6E-06 | 7.2E-06 |
| Indeno (1,2,3-cd)Pyrene | 0.047 | 0.91 | 1.3E-08 | 0.18 | 1.3E-07 | 3.0E-02 | 4.3E-07 | 4.5E-06 | 4.9E-06 |
| Phenanthrene | 0.042 | 0.91 | 1.1E-08 | 0.18 | 1.2E-07 | 3.0E-02 | 3.8E-07 | 4.0E-06 | 4.4E-06 |
| Pyrene | 0.063 | 1.00 | 1.9E-08 | 0.20 | 2.0E-07 | 3.0E-02 | 6.3E-07 | 6.7E-06 | 7.3E-06 |
| bis(2-EthylHexyl)phthalate | 0.083 | 1.00 | 2.5E-08 | 0.02 | 2.6E-08 | 2.0E-02 | 1.2E-06 | 1.3E-06 | 2.6E-06 |
| Aluminum | 4826.6667 | | | | | | | | |
| Arsenic | 8.0333 | 1.00 | 2.4E-06 | 0.03 | 3.8E-06 | 3.0E-04 | 8.0E-03 | 1.3E-02 | 2.1E-02 |
| Barium | 13.9167 | 0.71 | 3.0E-06 | 0.05 | 1.2E-05 | 7.0E-02 | 4.2E-05 | 1.7E-04 | 2.1E-04 |
| Calcium | 627.1833 | | | | | | | | |
| Chromium III | 15.75 | 1.00 | 4.7E-06 | 0.04 | 1.0E-05 | 1.0E+00 | 4.7E-06 | 1.0E-05 | 1.5E-05 |
| Chromium VI | 1.75 | 1.00 | 5.2E-07 | 0.09 | 2.5E-06 | 5.0E-03 | 1.0E-04 | 5.0E-04 | 6.1E-04 |
| Cobalt | 2.5417 | 1.86 | 1.4E-06 | 0.14 | 5.8E-06 | 1.8E-01 | 7.9E-06 | 3.2E-05 | 4.0E-05 |
| Iron | 6990 | | | | | | | | |
| Lead | 28.5 | 0.50 | 4.3E-06 | 0.01 | 2.7E-06 | 7.5E-04 | 5.7E-03 | 3.6E-03 | 9.3E-03 |
| Manganese | 109.15 | 1.86 | 6.1E-05 | 0.14 | 2.5E-04 | 4.7E-02 | 1.3E-03 | 5.3E-03 | 6.6E-03 |
| Nickel | 4.1 | 1.00 | 1.2E-06 | 0.35 | 2.3E-05 | 2.0E-02 | 6.1E-05 | 1.1E-03 | 1.2E-03 |
| Selenium | 0.5175 | 1.00 | 1.5E-07 | 0.00 | 1.6E-08 | 5.0E-03 | 3.1E-05 | 3.3E-06 | 3.4E-05 |

[1] MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
ND = no data available

MWSIDSLF
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SURFACE SOIL - SULFATE LANDFILL
RECEPTOR: FULL-TIME, LONG-TERM ON-SITE WORKER (PLANT B AREA AND MAINTENANCE ) - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-11

18-Jun-97
NONCARCINOGENIC EFFECTS (CONTINUED)

| | SOIL CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|
| Sodium | 37 | | | | | | | | |
| Thallium | 0.66 | 1.00 | 2.0E-07 | 0.01 | 1.0E-07 | 8.0E-05 | 2.5E-03 | 1.3E-03 | 3.8E-03 |
| Vanadium | 14.8333 | 0.71 | 3.1E-06 | 0.05 | 1.3E-05 | 7.0E-03 | 4.5E-04 | 1.8E-03 | 2.3E-03 |
| Zinc | 22.5167 | 1.00 | 6.7E-06 | 0.02 | 7.2E-06 | 3.0E-01 | 2.2E-05 | 2.4E-05 | 4.6E-05 |
| Chloride | 61.5 | | | | | | | | |
| Nitrogen, Ammonia | 17 | 0.71 | 3.6E-06 | 0.05 | 1.5E-05 | 3.7E-01 | 9.8E-06 | 4.0E-05 | 5.0E-05 |
| Sulfate as SO4 | 30.5 | | | | | | | | |
| | | | | | SUMMARY HAZARD INDEX | | 2E-02 | 3E-02 | 4E-02 |

[1] MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
ND = no data available

MWSINSLF
INHALATION EXPOSURE TO OHM IN SURFACE SOIL PARTICULATES - SULFATE LANDFILL
RECEPTOR: FULL-TIME, LONG-TERM ON-SITE WORKER (PLANT B AREA AND MAINTENANCE ) - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-12

18-Jun-97

EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| CONCENTRATION IN AIR | [RP]air | 32 | ug/m3 | MADEP, 1995 |
| CONCENTRATION IN SOIL | [OHM]part | chemical-specific | mg/kg | |
| CONVERSION FACTOR 1 | CF1 | 24 | hours/day | |
| EXPOSURE TIME DAILY (1) | ET | 2 | hours/day | Assumption |
| EXPOSURE FREQUENCY (2) | EF | 153 | days/year | Assumption |
| EXPOSURE DURATION | ED | 25 | years | USEPA, 1991 |
| CONVERSION FACTOR 2 | CF2 | 365 | days/year | |
| CONVERSION FACTOR 3 | CF3 | 0.000001 | kg/mg | |
| AVERAGING TIME CANCER | AT | 75 | years | MADEP, 1995 |
| AVERAGING TIME NONCANCER | AT | 25 | years | USEPA, 1991 |

(1) Values for residential exposure frequency used as a conservative estimate of outdoor worker exposure.

MADEP, 1995. Guidance for Disposal Site Risk Characterization, Interim Final Policy WSC/ORS-95-141. July.
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors." OSWER Directive 9285.6-03.

EQUATIONS

CANCER RISK = AVG. CONC. (ug/m3) * CANCER UNIT RISK (ug/m3)^-1

HAZARD QUOTIENT = AVG.CONC.(ug/m3)/REF. CONC. (ug/m3)

$$\text{AVG. EXPOSURE CONC.} = \frac{[OHM]air * EF * ET * ED}{AT * CF1 * CF2}$$

OHM AIR CONC. = [RP]air * [OHM]part * CF3

Note:
*For noncarcinogenic effects: AT = ED

MWSINSLF
INHALATION EXPOSURE TO OHM IN SURFACE SOIL PARTICULATES - SULFATE LANDFILL
RECEPTOR: FULL-TIME, LONG-TERM ON-SITE WORKER (PLANT B AREA AND MAINTENANCE ) - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-12

18-Jun-97

CARCINOGENIC EFFECTS

| COMPOUND | OHM SOIL CONCENTRATION (mg/kg) | OHM AIR CONCENTRATION (mg/m³) | AVERAGE AIR CONCENTRATION LIFETIME (mg/m3) | INHALATION CANCER UNIT RISK (mg/m3)^-1 | CANCER RISK |
|---|---|---|---|---|---|
| Benzo(a)Anthracene | 0.038 | 0.000001216 | 1.4E-08 | 1.1E-04 | 1.6E-12 |
| Benzo(a)Pyrene | 0.046 | 0.000001472 | 1.7E-08 | 1.1E-03 | 1.9E-11 |
| Benzo(b)Fluoranthene | 0.0665 | 0.000002128 | 2.5E-08 | 1.1E-04 | 2.7E-12 |
| Benzo(k)Fluoranthene | 0.018 | 0.000000576 | 6.7E-09 | 1.1E-05 | 7.4E-14 |
| Chrysene | 0.0445 | 0.000001424 | 1.7E-08 | 1.1E-06 | 1.8E-14 |
| Indeno (1,2,3-cd)Pyrene | 0.047 | 0.000001504 | 1.8E-08 | 1.1E-04 | 1.9E-12 |
| bis(2-EthylHexyl)phthalate | 0.083 | 0.000002656 | 3.1E-08 | 2.4E-06 | 7.4E-14 |
| Arsenic | 8.0333 | 0.000257066 | 3.0E-06 | 4.3E-03 | 1.3E-08 |
| Chromium VI | 1.75 | 0.000056 | 6.5E-07 | 1.2E-02 | 7.8E-09 |
| Lead | 28.5 | 0.000912 | 1.1E-05 | ND | |
| Nickel | 4.1 | 0.0001312 | 1.5E-06 | 2.4E-04 | 3.7E-10 |
| | | | SUMMARY CANCER RISK | | 2E-08 |

ND = No data available.

MWSINSLF
INHALATION EXPOSURE TO OHM IN SURFACE SOIL PARTICULATES - SULFATE LANDFILL
RECEPTOR: FULL-TIME, LONG-TERM ON-SITE WORKER (PLANT B AREA AND MAINTENANCE ) - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-12

18-Jun-97

NONCARCINOGENIC EFFECTS

| COMPOUND | OHM SOIL CONCENTRATION mg/kg | OHM AIR CONCENTRATION (ug/m³) | AVERAGE AIR CONCENTRATION FOR TIME PERIOD (ug/m3) | CHRONIC INHALATION RfC [1] (ug/m3) | HAZARD QUOTIENT |
|---|---|---|---|---|---|
| Toluene | 0.003 | 0.000000096 | 3.4E-09 | 400 | 8.4E-12 |
| Benzo(a)Anthracene | 0.038 | 0.000001216 | 4.2E-08 | 71 | 6.0E-10 |
| Benzo(a)Pyrene | 0.046 | 0.000001472 | 5.1E-08 | 71 | 7.2E-10 |
| Benzo(b)Fluoranthene | 0.0665 | 0.000002128 | 7.4E-08 | 71 | 1.0E-09 |
| Benzo(g,h,i)Perylene | 0.029 | 0.000000928 | 3.2E-08 | 71 | 4.6E-10 |
| Benzo(k)Fluoranthene | 0.018 | 0.000000576 | 2.0E-08 | 71 | 2.8E-10 |
| Chrysene | 0.0445 | 0.000001424 | 5.0E-08 | 71 | 7.0E-10 |
| Di-n-butylphthalate | 0.017 | 0.000000544 | 1.9E-08 | 7 | 2.7E-09 |
| Fluoranthene | 0.0825 | 0.00000264 | 9.2E-08 | 71 | 1.3E-09 |
| Indeno (1,2,3-cd)Pyrene | 0.047 | 0.000001504 | 5.3E-08 | 71 | 7.4E-10 |
| Phenanthrene | 0.042 | 0.000001344 | 4.7E-08 | 71 | 6.6E-10 |
| Pyrene | 0.063 | 0.000002016 | 7.0E-08 | 71 | 9.9E-10 |
| bis(2-EthylHexyl)phthalate | 0.083 | 0.000002656 | 9.3E-08 | 7 | 1.3E-08 |
| Aluminum | 4826.6667 | 0.154453334 | 5.4E-03 | | |
| Arsenic | 8.0333 | 0.000257066 | 9.0E-06 | 0.0025 | 3.6E-03 |
| Barium | 13.9167 | 0.000445334 | 1.6E-05 | 0.5 | 3.1E-05 |
| Calcium | 627.1833 | 0.020069866 | 7.0E-04 | | |
| Chromium III | 15.75 | 0.000504 | 1.8E-05 | 6.8 | 2.6E-06 |
| Chromium VI | 1.75 | 0.000056 | 2.0E-06 | 0.02 | 9.8E-05 |
| Cobalt | 2.5417 | 8.13344E-05 | 2.8E-06 | | |
| Iron | 6990 | 0.22368 | 7.8E-03 | | |
| Lead | 28.5 | 0.000912 | 3.2E-05 | 0.7 | 4.6E-05 |
| Manganese | 109.15 | 0.0034928 | 1.2E-04 | 0.05 | 2.4E-03 |
| Nickel | 4.1 | 0.0001312 | 4.6E-06 | 0.009 | 5.1E-04 |
| Selenium | 0.5175 | 0.00001656 | 5.8E-07 | 2.7 | 2.1E-07 |

MWSINSLF
INHALATION EXPOSURE TO OHM IN SURFACE SOIL PARTICULATES - SULFATE LANDFILL
RECEPTOR: FULL-TIME, LONG-TERM ON-SITE WORKER (PLANT B AREA AND MAINTENANCE ) - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-12

18-Jun-97

NONCARCINOGENIC EFFECTS

| COMPOUND | OHM SOIL CONCENTRATION mg/kg | OHM AIR CONCENTRATION (ug/m³) | AVERAGE AIR CONCENTRATION FOR TIME PERIOD (ug/m3) | CHRONIC INHALATION RfC [1] (ug/m3) | HAZARD QUOTIENT |
|---|---|---|---|---|---|
| Sodium | 37 | 0.001184 | 4.1E-05 | | |
| Thallium | 0.66 | 0.00002112 | 7.4E-07 | | |
| Vanadium | 14.8333 | 0.000474666 | 1.7E-05 | 1.4 | 1.2E-05 |
| Zinc | 22.5167 | 0.000720534 | 2.5E-05 | | |
| Chloride | 61.5 | 0.001968 | 6.9E-05 | | |
| Nitrogen, Ammonia | 17 | 0.000544 | 1.9E-05 | 100 | 1.9E-07 |
| Sulfate as SO4 | 30.5 | 0.000976 | 3.4E-05 | | |
| | | | SUMMARY HAZARD INDEX | | 7E-03 |

ND = No data available.

MWSIDALF
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SURFACE SOIL - ENTIRE SITE (EXLUDING SULFATE LANDFILL)
RECEPTOR: FULL-TIME, LONG-TERM ON-SITE WORKER (PLANT B AREA AND MAINTENANCE) - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-13

19-Jun-97

EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| CONCENTRATION SOIL | $[OHM]_{soil}$ | chemical specific | chemical-specific | |
| INGESTION RATE | IR | 50 | mg-soil/day | MADEP, 1995 |
| ADHERENCE FACTOR | AF | 0.51 | mg-soil/cm²-skin | MADEP, 1995 |
| AVERAGE SURFACE AREA (1) | SA | 5,200 | cm²/day | calculated per MADEP, 1995 |
| RELATIVE ABSORPTION FACTOR-ORAL | RAF-O | chemical specific | unitless | MADEP, 1994, 1995 |
| RELATIVE ABSORPTION FACTOR -DERM | RAF-D | chemical specific | unitless | MADEP, 1994, 1995 |
| CONVERSION FACTOR | CF | 1.00E-06 | kg/mg | |
| BODY WEIGHT | BW | 70 | kg | USEPA, 1989 |
| EXPOSURE PERIOD | EP | 25 | years | USEPA, 1991 |
| EXPOSURE FREQUENCY (2) | EF | 153 | events/year | Assumption |
| EXPOSURE DURATION (2) | ED | 1 | day/event | Assumption |
| AVERAGING PERIOD | | | | |
| CANCER | AP | 75 | years | MADEP, 1995 |
| NONCANCER | AP | 25 | years | USEPA, 1991 |

(1) 50th percentile of surface areas for males: head, hands, arms.
(2) Values for residential exposure frequency used as a conservative estimate of outdoor worker exposure.

MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
MADEP, 1995. Guidance for Disposal Site Risk Characterization. Interim Final Policy WSC/ORS-95-141. July 1995.
USEPA, 1989. Exposure Factors Handbook. EPA/600/8-89/043. May 1989.
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors." OSWER Directive 9285.6-03.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)^-1

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE-INGESTION} = \frac{[OHM]soil \times IR \times RAF\text{-}O \times CF \times EF \times ED \times EP}{BW \times AP \times 365\ days/yr}$$

$$\text{INTAKE-DERMAL} = \frac{[OHM]soil \times SA \times AF \times RAF\text{-}D \times EF \times ED \times EP \times CF}{BW \times AP \times 365\ days/yr}$$

MWSIDALF
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SURFACE SOIL - ENTIRE SITE (EXLUDING SULFATE LANDFILL)
RECEPTOR: FULL-TIME, LONG-TERM ON-SITE WORKER (PLANT B AREA AND MAINTENANCE ) - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-13

19-Jun-97

CARCINOGENIC EFFECTS

| | SOIL CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | CANCER SLOPE FACTOR (mg/kg-day)-1 | CANCER RISK INGESTION | CANCER RISK DERMAL | TOTAL CANCER RISK |
|---|---|---|---|---|---|---|---|---|---|
| 1,1-Dichloroethene | 0.00098 | 1.02 | 1.0E-10 | 0.10 | 5.3E-10 | 6.0E-01 | 6.0E-11 | 3.2E-10 | 3.8E-10 |
| Methylene Chloride | 0 0022 | 1.00 | 2.2E-10 | 0.10 | 1.2E-09 | 7.5E-03 | 1.6E-12 | 8.7E-12 | 1.0E-11 |
| Tetrachloroethene (PCE) | 0.0019 | 1.00 | 1.9E-10 | 0.10 | 1.0E-09 | 5.1E-02 | 9.7E-12 | 5.1E-11 | 6.1E-11 |
| 2-Methylphenol (o-Cresol) | 0.0015 | | | | | ND | | | |
| Benzo(a)Anthracene | 0.32 | 1.00 | 3.2E-08 | 0.20 | 3.4E-07 | 7.3E-01 | 2.3E-08 | 2.5E-07 | 2.7E-07 |
| Benzo(a)Pyrene | 0.24 | 1.00 | 2.4E-08 | 0.20 | 2.5E-07 | 7.3E+00 | 1.7E-07 | 1.9E-06 | 2.0E-06 |
| Benzo(b)Fluoranthene | 0.23 | 1.00 | 2.3E-08 | 0.20 | 2.4E-07 | 7.3E-01 | 1.7E-08 | 1.8E-07 | 1.9E-07, |
| Benzo(k)Fluoranthene | 0 2 | 1.00 | 2.0E-08 | 0.20 | 2.1E-07 | 7.3E-02 | 1.5E-09 | 1.5E-08 | 1.7E-08 |
| Butylbenzylphthalate | 0.12 | | | | | ND | | | |
| Chrysene | 0.4 | 1.00 | 4.0E-08 | 0.20 | 4.2E-07 | 7.3E-03 | 2.9E-10 | 3.1E-09 | 3.4E-09 |
| Indeno (1,2,3-cd)Pyrene | 0 12 | 1.00 | 1.2E-08 | 0.20 | 1.3E-07 | 7.3E-01 | 8.7E-09 | 9.3E-08 | 1.0E-07 |
| N-Nitrosodiphenylamine | 0.96 | 0.91 | 8 7E-08 | 0.17 | 8.6E-07 | 4.9E-03 | 4.3E-10 | 4.2E-09 | 4.7E-09 |
| bis(2-EthylHexyl)phthalate | 36.8 | 1.00 | 3.7E-06 | 0.02 | 3.9E-06 | 1.4E-02 | 5 1E-08 | 5.5E-08 | 1.1E-07 |
| 4,4'-DDD | 0.013 | 1.00 | 1.3E-09 | 0.20 | 1.4E-08 | 2.4E-01 | 3.1E-10 | 3.3E-09 | 3.6E-09 |
| 4,4'-DDE | 0.015 | 1.00 | 1.5E-09 | 0.20 | 1.6E-08 | 3.4E-01 | 5.1E-10 | 5.4E-09 | 5.9E-09 |
| 4,4'-DDT | 0.096 | 1.00 | 9.6E-09 | 0.20 | 1.0E-07 | 3.4E-01 | 3.3E-09 | 3.5E-08 | 3.8E-08 |
| Aldrin | 0.00072 | 1.00 | 7.2E-11 | 0.25 | 9.5E-10 | 1.7E+01 | 1.2E-09 | 1 6E-08 | 1.7E-08 |
| Alpha-BHC | 0.0014 | 0.96 | 1.3E-10 | 0.18 | 1.3E-09 | 6 3E+00 | 8.4E-10 | 8.4E-09 | 9.2E-09 |
| Alpha-Chlordane | 0.0004 | 1.00 | 4.0E-11 | 0.05 | 1.1E-10 | 1.3E+00 | 5.2E-11 | 1.4E-10 | 1 9E-10 |
| Dieldrin | 0.00041 | 1.00 | 4.1E-11 | 0.25 | 5.4E-10 | 1.6E+01 | 6.5E-10 | 8.7E-09 | 9.3E-09 |
| Gamma-BHC (Lindane) | 0.006 | 1.00 | 6.0E-10 | 0.20 | 6.4E-09 | 1.3E+00 | 7.8E-10 | 8.3E-09 | 9.0E-09 |
| Gamma-Chlordane | 0.0012 | 1.00 | 1.2E-10 | 0.05 | 3.2E-10 | 1.3E+00 | 1.6E-10 | 4.1E-10 | 5.7E-10 |
| Heptachlor | 0.00002 | 1.00 | 2.0E-12 | 0.20 | 2.1E-11 | 4.5E+00 | 9.0E-12 | 9.5E-11 | 1.0E-10 |
| Heptachlor Epoxide | 0.00011 | 1.00 | 1.1E-11 | 0.20 | 1.2E-10 | 9.1E+00 | 1.0E-10 | 1.1E-09 | 1.2E-09 |
| PCB-1016 | 0.0156408 | 0.85 | 1.3E-09 | 0.07 | 5.8E-09 | 2 0E+00 | 2.7E-09 | 1 2E-08 | 1.4E-08 |
| Arsenic | 8.95 | 1.00 | 8.9E-07 | 0.03 | 1.4E-06 | 1.5E+00 | 1.3E-06 | 2.1E-06 | 3.5E-06 |
| Beryllium | 0.038 | 1.00 | 3.8E-09 | 0.03 | 6.0E-09 | 4.3E+00 | 1.6E-08 | 2.6E-08 | 4.2E-08 |
| Cadmium | 0.41 | | | | | ND | | | |
| Lead | 43.5 | | | | | ND | | | |
| | | | | | | SUMMARY CANCER RISK | 2E-06 | 5E-06 | 6E-06 |

[1] MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
ND = no data available

ABB-Environmental Services, Inc.
MWSIDALF.XLS
6/19/97 9:30 AM

MWSIDALF
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SURFACE SOIL - ENTIRE SITE (EXLUDING SULFATE LANDFILL)
RECEPTOR: FULL-TIME, LONG-TERM ON-SITE WORKER (PLANT B AREA AND MAINTENANCE ) - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-13

19-Jun-97

NONCARCINOGENIC EFFECTS

| COMPOUND | SOIL CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|
| 1,1,1-Trichloroethane | 0.005703735 | 1.00 | 1.7E-09 | 0.10 | 9.1E-09 | 9.0E-01 | 1.9E-09 | 1.0E-08 | 1.2E-08 |
| 1,1-Dichloroethane | 0.00098 | 1.00 | 2.9E-10 | 0.10 | 1.6E-09 | 9.0E-03 | 3.3E-08 | 1.7E-07 | 2.1E-07 |
| 2,4,4-Trimethyl-1-pentene | 0.00013 | 0.99 | 3.9E-11 | 0.11 | 2.3E-10 | 2.1E-01 | 1.9E-10 | 1.1E-09 | 1.3E-09 |
| 2-Butanone (MEK) | 0.00015 | 1.00 | 4.5E-11 | 0.10 | 2.4E-10 | 6.0E-01 | 7.5E-11 | 4.0E-10 | 4.7E-10 |
| Acetone | 0.006 | 1.00 | 1.8E-09 | 0.10 | 9.5E-09 | 1.0E-01 | 1.8E-08 | 9.5E-08 | 1.1E-07 |
| Methylene Chloride | 0.0022 | 1.00 | 6.6E-10 | 0.10 | 3.5E-09 | 6.0E-02 | 1.1E-08 | 5.8E-08 | 6.9E-08 |
| Tetrachloroethene (PCE) | 0.0019 | 1.00 | 5.7E-10 | 0.10 | 3.0E-09 | 1.0E-02 | 5.7E-08 | 3.0E-07 | 3.6E-07 |
| Toluene | 0.003 | 1.00 | 9.0E-10 | 0.12 | 5.7E-09 | 2.0E-01 | 4.5E-09 | 2.9E-08 | 3.3E-08 |
| 2-Methylnaphthalene | 0.879198638 | 1.00 | 2.6E-07 | 0.20 | 2.8E-06 | 3.0E-02 | 8.8E-06 | 9.3E-05 | 1.0E-04 |
| 2-Methylphenol (o-Cresol) | 0.001512875 | 1.00 | 4.5E-10 | 0.19 | 4.5E-09 | 5.0E-02 | 9.1E-09 | 9.0E-08 | 9.9E-08 |
| Acenaphthene | 0.261946588 | 1.00 | 7.8E-08 | 0.20 | 8.3E-07 | 6.0E-02 | 1.3E-06 | 1.4E-05 | 1.5E-05 |
| Acenaphthylene | 0.672812219 | 0.91 | 1.8E-07 | 0.18 | 1.9E-06 | 3.0E-02 | 6.1E-06 | 6.4E-05 | 7.0E-05 |
| Anthracene | 0.478312424 | 1.00 | 1.4E-07 | 0.29 | 2.2E-06 | 3.0E-01 | 4.8E-07 | 7.3E-06 | 7.8E-06 |
| Benzo(a)Anthracene | 0.324203528 | 0.91 | 8.8E-08 | 0.18 | 9.3E-07 | 3.0E-02 | 2.9E-06 | 3.1E-05 | 3.4E-05 |
| Benzo(a)Pyrene | 0.235040688 | 0.91 | 6.4E-08 | 0.18 | 6.7E-07 | 3.0E-02 | 2.1E-06 | 2.2E-05 | 2.5E-05 |
| Benzo(b)Fluoranthene | 0.229120909 | 0.91 | 6.2E-08 | 0.18 | 6.5E-07 | 3.0E-02 | 2.1E-06 | 2.2E-05 | 2.4E-05 |
| Benzo(g,h,i)Perylene | 0.125041613 | 0.91 | 3.4E-08 | 0.18 | 3.6E-07 | 3.0E-02 | 1.1E-06 | 1.2E-05 | 1.3E-05 |
| Benzo(k)Fluoranthene | 0.197122963 | 0.91 | 5.4E-08 | 0.18 | 5.6E-07 | 3.0E-02 | 1.8E-06 | 1.9E-05 | 2.1E-05 |
| Benzoic Acid | 0.237990488 | 0.96 | 6.8E-08 | 0.18 | 6.8E-07 | 4.0E+00 | 1.7E-08 | 1.7E-07 | 1.9E-07 |
| Butylbenzylphthalate | 0.119146212 | 0.96 | 3.4E-08 | 0.18 | 3.4E-07 | 2.0E-01 | 1.7E-07 | 1.7E-06 | 1.9E-06 |
| Chrysene | 0.401210309 | 0.91 | 1.1E-07 | 0.18 | 1.1E-06 | 3.0E-02 | 3.6E-06 | 3.8E-05 | 4.2E-05 |
| Di-n-butylphthalate | 0.150027126 | 0.96 | 4.3E-08 | 0.18 | 4.3E-07 | 1.0E-01 | 4.3E-07 | 4.3E-06 | 4.7E-06 |
| Di-n-octylphthalate | 0.066453166 | 0.96 | 1.9E-08 | 0.18 | 1.9E-07 | 2.0E-02 | 9.5E-07 | 9.4E-06 | 1.0E-05 |
| Dibenzofuran | 0.069438498 | 1.00 | 2.1E-08 | 0.19 | 2.1E-07 | 3.0E-02 | 6.9E-07 | 6.9E-06 | 7.6E-06 |
| Diethylpthalate | 0.033177641 | 1.00 | 9.9E-09 | 0.02 | 1.1E-08 | 8.0E-01 | 1.2E-08 | 1.3E-08 | 2.6E-08 |
| Fluoranthene | 0.841264099 | 1.00 | 2.5E-07 | 0.20 | 2.7E-06 | 4.0E-02 | 6.3E-06 | 6.7E-05 | 7.3E-05 |
| Fluorene | 0.644011598 | 1.00 | 1.9E-07 | 0.20 | 2.0E-06 | 4.0E-02 | 4.8E-06 | 5.1E-05 | 5.6E-05 |
| Indeno (1,2,3-cd)Pyrene | 0.120731463 | 0.91 | 3.3E-08 | 0.18 | 3.5E-07 | 3.0E-02 | 1.1E-06 | 1.2E-05 | 1.3E-05 |
| N-Nitrosodiphenylamine | 0.958531552 | 0.96 | 2.7E-07 | 0.18 | 2.7E-06 | 5.0E-02 | 5.5E-06 | 5.4E-05 | 6.0E-05 |
| Naphthalene | 0.868425164 | 1.00 | 2.6E-07 | 0.10 | 1.4E-06 | 4.0E-02 | 6.5E-06 | 3.4E-05 | 4.1E-05 |
| Phenanthrene | 1.713341869 | 0.91 | 4.7E-07 | 0.18 | 4.9E-06 | 3.0E-02 | 1.6E-05 | 1.6E-04 | 1.8E-04 |
| Phenol | 0.114741 | 1.00 | 3.4E-08 | 0.26 | 4.7E-07 | 6.0E-01 | 5.7E-08 | 7.9E-07 | 8.5E-07 |

MWSIDALF
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SURFACE SOIL - ENTIRE SITE (EXLUDING SULFATE LANDFILL)
RECEPTOR: FULL-TIME, LONG-TERM ON-SITE WORKER (PLANT B AREA AND MAINTENANCE ) - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-13

19-Jun-97

NONCARCINOGENIC EFFECTS

| COMPOUND | SOIL CONCENTRATION (mg/kg) | INGESTION RAF [-] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [-] | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|
| Pyrene | 0.675631496 | 1.00 | 2.0E-07 | 0.20 | 2.1E-06 | 3.0E-02 | 6.7E-06 | 7.2E-05 | 7.8E-05 |
| bis(2-Ethylhexyl)phthalate | 36.78097434 | 1.00 | 1.1E-05 | 0.02 | 1.2E-05 | 2.0E-02 | 5.5E-04 | 5.8E-04 | 1.1E-03 |
| 4,4'-DDD | 0.013111998 | 0.96 | 3.8E-09 | 0.18 | 3.7E-08 | 5.0E-04 | 7.5E-06 | 7.5E-05 | 8.2E-05 |
| 4,4'-DDE | 0.014614968 | 0.96 | 4.2E-09 | 0.18 | 4.2E-08 | 5.0E-04 | 8.4E-06 | 8.3E-05 | 9.1E-05 |
| 4,4'-DDT | 0.096166259 | 0.96 | 2.8E-08 | 0.18 | 2.7E-07 | 5.0E-04 | 5.5E-05 | 5.5E-04 | 6.0E-04 |
| Aldrin | 0.000723725 | 1.00 | 2.2E-10 | 0.25 | 2.9E-09 | 3.0E-05 | 7.2E-06 | 9.6E-05 | 1.0E-04 |
| Alpha-BHC | 0.001439505 | 0.96 | 4.1E-10 | 0.18 | 4.1E-09 | 5.0E-04 | 8.3E-07 | 8.2E-06 | 9.0E-06 |
| Alpha-Chlordane | 0.000397946 | 1.00 | 1.2E-10 | 0.05 | 3.2E-10 | 6.0E-05 | 2.0E-06 | 5.3E-06 | 7.3E-06 |
| Dieldrin | 0.000410428 | 1.00 | 1.2E-10 | 0.25 | 1.6E-09 | 5.0E-05 | 2.5E-06 | 3.3E-05 | 3.5E-05 |
| Endosulfan I | 0.000718312 | 0.96 | 2.1E-10 | 0.18 | 2.0E-09 | 6.0E-03 | 3.4E-08 | 3.4E-07 | 3.7E-07 |
| Endosulfan II | 0.00353234 | 0.96 | 1.0E-09 | 0.18 | 1.0E-08 | 6.0E-03 | 1.7E-07 | 1.7E-06 | 1.8E-06 |
| Endrin | 0.001643931 | 1.00 | 4.9E-10 | 0.25 | 6.5E-09 | 3.0E-04 | 1.6E-06 | 2.2E-05 | 2.3E-05 |
| Endrin Ketone | 0.000442317 | 0.96 | 1.3E-10 | 0.18 | 1.3E-09 | 3.0E-04 | 4.2E-07 | 4.2E-06 | 4.6E-06 |
| Gamma-BHC (Lindane) | 0.006027576 | 1.00 | 1.8E-09 | 0.20 | 1.9E-08 | 3.0E-04 | 6.0E-06 | 6.4E-05 | 7.0E-05 |
| Gamma-Chlordane | 0.001246558 | 1.00 | 3.7E-10 | 0.05 | 9.9E-10 | 6.0E-05 | 6.2E-06 | 1.6E-05 | 2.3E-05 |
| Heptachlor | 0.000019604 | 1.00 | 5.9E-12 | 0.20 | 6.2E-11 | 5.0E-04 | 1.2E-08 | 1.2E-07 | 1.4E-07 |
| Heptachlor Epoxide | 0.000111338 | 1.00 | 3.3E-11 | 0.20 | 3.5E-10 | 1.3E-05 | 2.6E-06 | 2.7E-05 | 3.0E-05 |
| PCB-1016 | 0.0156408 | 0.96 | 4.5E-09 | 0.18 | 4.4E-08 | 7.0E-05 | 6.4E-05 | 6.3E-04 | 7.0E-04 |
| Aluminum | 5,353 | | | | | | | | |
| Antimony | 1.576214112 | 1.00 | 4.7E-07 | 0.10 | 2.5E-06 | 4.0E-04 | 1.2E-03 | 6.3E-03 | 7.4E-03 |
| Arsenic | 8.949406915 | 1.00 | 2.7E-06 | 0.03 | 4.3E-06 | 3.0E-04 | 8.9E-03 | 1.4E-02 | 2.3E-02 |
| Barium | 20.63628698 | 0.71 | 4.4E-06 | 0.05 | 1.8E-05 | 7.0E-02 | 6.3E-05 | 2.6E-04 | 3.2E-04 |
| Beryllium | 0.037884618 | 1.00 | 1.1E-08 | 0.03 | 1.8E-08 | 5.0E-03 | 2.3E-06 | 3.6E-06 | 5.9E-06 |
| Cadmium | 0.4091042 | 1.00 | 1.2E-07 | 0.14 | 9.1E-07 | 5.0E-04 | 2.4E-04 | 1.8E-03 | 2.1E-03 |
| Calcium | 1,471 | | | | | | | | |
| Chromium III | 125.0194879 | 1.00 | 3.7E-05 | 0.04 | 7.9E-05 | 1.0E+00 | 3.7E-05 | 7.9E-05 | 1.2E-04 |
| Chromium VI | 13.89105421 | 1.00 | 4.2E-06 | 0.09 | 2.0E-05 | 5.0E-03 | 8.3E-04 | 4.0E-03 | 4.8E-03 |
| Cobalt | 2.889568709 | 1.86 | 1.6E-06 | 0.14 | 6.6E-06 | 6.0E-02 | 2.7E-05 | 1.1E-04 | 1.4E-04 |
| Cyanide | 0.202692 | 1.00 | 6.1E-08 | 0.30 | 9.7E-07 | 2.0E-02 | 3.0E-06 | 4.8E-05 | 5.1E-05 |
| Iron | 8,016 | | | | | | | | |
| Lead | 43.48869863 | 0.50 | 6.5E-06 | 0.01 | 4.1E-06 | 7.5E-04 | 8.7E-03 | 5.5E-03 | 1.4E-02 |
| Manganese | 83.4918863 | 1.86 | 4.6E-05 | 0.14 | 1.9E-04 | 4.7E-02 | 9.9E-04 | 4.0E-03 | 5.0E-03 |
| Mercury | 0.114384115 | 1.00 | 3.4E-08 | 0.05 | 9.1E-08 | 3.0E-04 | 1.1E-04 | 3.0E-04 | 4.2E-04 |
| Nickel | 7.743232825 | 1.00 | 2.3E-06 | 0.35 | 4.3E-05 | 2.0E-02 | 1.2E-04 | 2.2E-03 | 2.3E-03 |
| Selenium | 0.553873945 | 1.00 | 1.7E-07 | 0.00 | 1.8E-08 | 5.0E-03 | 3.3E-05 | 3.5E-06 | 3.7E-05 |
| Sodium | 58.9900546 | | | | | | | | |
| Thallium | 0.469300628 | 1.00 | 1.4E-07 | 0.01 | 7.5E-08 | 8.0E-05 | 1.8E-03 | 9.3E-04 | 2.7E-03 |
| Vanadium | 16.58144156 | 0.71 | 3.5E-06 | 0.05 | 1.4E-05 | 7.0E-03 | 5.0E-04 | 2.1E-03 | 2.6E-03 |
| Zinc | 41.88665588 | 1.00 | 1.3E-05 | 0.02 | 1.3E-05 | 3.0E-01 | 4.2E-05 | 4.4E-05 | 8.6E-05 |
| Chloride | 44.1126819 | | | | | | | | |
| Nitrogen, Ammonia | 62.87137744 | 0.71 | 1.3E-05 | 0.05 | 5.4E-05 | 3.7E-01 | 3.6E-05 | 1.5E-04 | 1.8E-04 |
| Sulfate as SO4 | 1,227 | | | | | | | | |
| | | | | | | SUMMARY HAZARD INDEX | 2E-02 | 4E-02 | 7E-02 |

ABB-Environmental Services, Inc.
MWSIDALF.XLS
6/19/97 9:30 AM

MWSINALF
INHALATION EXPOSURE TO OHM IN SURFACE SOIL PARTICULATES - ENTIRE SITE (EXCLUDING SULFATE LANDFILL)
RECEPTOR: FULL-TIME, LONG-TERM ON-SITE WORKER (PLANT B AREA AND MAINTENANCE ) - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-14

18-Jun-97

EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| CONCENTRATION IN AIR | [RP]air | 32 | ug/m3 | MADEP, 1995 |
| CONCENTRATION IN SOIL | [OHM]part | chemical-specific | mg/kg | |
| CONVERSION FACTOR 1 | CF1 | 24 | hours/day | |
| EXPOSURE TIME DAILY (1) | ET | 8 | hours/day | Assumption |
| EXPOSURE FREQUENCY (1) | EF | 153 | days/year | MADEP, 1995 |
| EXPOSURE DURATION | ED | 25 | years | USEPA, 1991 |
| CONVERSION FACTOR 2 | CF2 | 365 | days/year | |
| CONVERSION FACTOR 3 | CF3 | 0.000001 | kg/mg | |
| AVERAGING TIME CANCER | AT | 75 | years | MADEP, 1995 |
| AVERAGING TIME NONCANCER | AT | 25 | years | USEPA, 1991 |

(1) Values for residential exposure frequency used as a conservative estimate of outdoor worker exposure.

MADEP, 1995. Guidance for Disposal Site Risk Characterization, Interim Final Policy WSC/ORS-95-141. July.
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors." OSWER Directive 9285.6-03.

EQUATIONS

CANCER RISK = AVG. CONC. (ug/m3) * CANCER UNIT RISK (ug/m3)^-1

HAZARD QUOTIENT = AVG.CONC.(ug/m3)/REF. CONC. (ug/m3)

$$\text{AVG. EXPOSURE CONC.} = \frac{[OHM]air \cdot EF \cdot ET \cdot ED}{AT \cdot CF1 \cdot CF2}$$

OHM AIR CONC. = [RP]air * [OHM]part * CF3

Note:
*For noncarcinogenic effects: AT = ED

MWSINALF
INHALATION EXPOSURE TO OHM IN SURFACE SOIL PARTICULATES - ENTIRE SITE (EXCLUDING SULFATE LANDFILL)
RECEPTOR: FULL-TIME, LONG-TERM ON-SITE WORKER (PLANT B AREA AND MAINTENANCE ) - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-14

18-Jun-97

CARCINOGENIC EFFECTS

| COMPOUND | OHM SOIL CONCENTRATION (mg/kg) | OHM AIR CONCENTRATION (ug/m3) | AVERAGE AIR CONCENTRATION LIFETIME (ug/m3) | INHALATION CANCER UNIT RISK (ug/m3)^-1 | CANCER RISK |
|---|---|---|---|---|---|
| 1,1-Dichloroethene | 0.00098 | 3.136E-08 | 1.5E-09 | 5.0E-05 | 7.3E-14 |
| Methylene Chloride | 0.0022 | 7.04E-08 | 3.3E-09 | 4.7E-07 | 1.5E-15 |
| Tetrachloroethene (PCE) | 0.0019 | 6.08E-08 | 2.8E-09 | 5.9E-06 | 1.7E-14 |
| 2-Methylphenol (o-Cresol) | 0.0015 | 0.000000048 | 2.2E-09 | ND | |
| Benzo(a)Anthracene | 0.32 | 0.00001024 | 4.8E-07 | 1.1E-04 | 5.2E-11 |
| Benzo(a)Pyrene | 0.24 | 0.00000768 | 3.6E-07 | 1.1E-03 | 3.9E-10 |
| Benzo(b)Fluoranthene | 0.23 | 0.00000736 | 3.4E-07 | 1.1E-04 | 3.8E-11 |
| Benzo(k)Fluoranthene | 0.2 | 0.0000064 | 3.0E-07 | 1.1E-05 | 3.3E-12 |
| Butylbenzylphthalate | 0.12 | 0.00000384 | 1.8E-07 | ND | |
| Chrysene | 0.4 | 0.0000128 | 6.0E-07 | 1.1E-06 | 6.6E-13 |
| Indeno (1,2,3-cd)Pyrene | 0.12 | 0.00000384 | 1.8E-07 | 1.1E-04 | 2.0E-11 |
| N-Nitrosodiphenylamine | 0.96 | 0.00003072 | 1.4E-06 | 2.6E-06 | 3.7E-12 |
| bis(2-EthylHexyl)phthalate | 36.8 | 0.0011776 | 5.5E-05 | 2.4E-06 | 1.3E-10 |
| 4,4'-DDD | 0.013 | 0.000000416 | 1.9E-08 | 9.7E-05 | 1.9E-12 |
| 4,4'-DDE | 0.015 | 0.00000048 | 2.2E-08 | 9.7E-05 | 2.2E-12 |
| 4,4'-DDT | 0.096 | 0.000003072 | 1.4E-07 | 9.7E-05 | 1.4E-11 |
| Aldrin | 0.00072 | 2.304E-08 | 1.1E-09 | 4.9E-03 | 5.3E-12 |
| Alpha-BHC | 0.0014 | 4.48E-08 | 2.1E-09 | 1.8E-03 | 3.8E-12 |
| Alpha-Chlordane | 0.0004 | 1.28E-08 | 6.0E-10 | 3.7E-04 | 2.2E-13 |
| Dieldrin | 0.00041 | 1.312E-08 | 6.1E-10 | 4.6E-03 | 2.8E-12 |
| Gamma-BHC (Lindane) | 0.006 | 0.000000192 | 8.9E-09 | 1.8E-05 | 1.6E-13 |
| Gamma-Chlordane | 0.0012 | 3.84E-08 | 1.8E-09 | 3.7E-04 | 6.6E-13 |
| Heptachlor | 0.00002 | 6.4E-10 | 3.0E-11 | 1.3E-03 | 3.9E-14 |
| Heptachlor Epoxide | 0.00011 | 3.52E-09 | 1.6E-10 | 2.6E-03 | 4.3E-13 |
| PCB-1016 | 0.0156408 | 5.00506E-07 | 2.3E-08 | | |
| Arsenic | 8.95 | 0.0002864 | 1.3E-05 | 4.3E-03 | 5.7E-08 |
| Beryllium | 0.038 | 0.000001216 | 5.7E-08 | 2.4E-03 | 1.4E-10 |
| Cadmium | 0.41 | 0.00001312 | 6.1E-07 | 1.8E-03 | 1.1E-09 |
| Chromium VI | 13.9 | 0.0004448 | 2.1E-05 | 1.2E-02 | 2.5E-07 |
| Lead | 43.5 | 0.001392 | 6.5E-05 | ND | |
| Nickel | 7.74 | 0.000247783 | 1.2E-05 | 2.4E-04 | 2.8E-09 |
| | | | | SUMMARY CANCER RISK | 3E-07 |

ND = No data available.

MWSINALF
INHALATION EXPOSURE TO OHM IN SURFACE SOIL PARTICULATES - ENTIRE SITE (EXCLUDING SULFATE LANDFILL)
RECEPTOR: FULL-TIME, LONG-TERM ON-SITE WORKER (PLANT B AREA AND MAINTENANCE ) - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-14

18-Jun-97
NONCARCINOGENIC EFFECTS

| COMPOUND | OHM SOIL CONCENTRATION mg/kg | OHM AIR CONCENTRATION (ug/m³) | AVERAGE AIR CONCENTRATION FOR TIME PERIOD (ug/m3) | CHRONIC INHALATION RfC [1] (ug/m3) | HAZARD QUOTIENT |
|---|---|---|---|---|---|
| 1,1,1-Trichloroethane | 0.005703735 | 1.8252E-07 | 2.6E-08 | 1000 | 2.6E-11 |
| 1,1-Dichloroethene | 0.00098 | 3.136E-08 | 4.4E-09 | 50 | 8.8E-11 |
| 2,4,4-Trimethyl-1-pentene | 0.00013 | 4.16E-09 | 5.8E-10 | 717.5 | 8.1E-13 |
| 2-Butanone (MEK) | 0.00015 | 4.8E-09 | 6.7E-10 | 1000 | 6.7E-13 |
| Acetone | 0.006 | 0.000000192 | 2.7E-08 | 800 | 3.4E-11 |
| Methylene Chloride | 0.0022 | 7.04E-08 | 9.8E-09 | 3000 | 3.3E-12 |
| Tetrachloroethene (PCE) | 0.0019 | 6.08E-08 | 8.5E-09 | 4600 | 1.8E-12 |
| Toluene | 0.003 | 0.000000096 | 1.3E-08 | 400 | 3.4E-11 |
| 2-Methylnaphthalene | 0.879198638 | 2.81344E-05 | 3.9E-06 | 71 | 5.5E-08 |
| 2-Methylphenol (o-Cresol) | 0.001512875 | 4.8412E-08 | 6.8E-09 | 100 | 6.8E-11 |
| Acenaphthene | 0.3 | 8.38229E-06 | 1.2E-06 | 71 | 1.6E-08 |
| Acenaphthylene | 0.672812219 | 2.153E-05 | 3.0E-06 | 71 | 4.2E-08 |
| Anthracene | 0.478312424 | 1.5306E-05 | 2.1E-06 | 71 | 3.0E-08 |
| Benzo(a)Anthracene | 0.324203528 | 1.03745E-05 | 1.4E-06 | 71 | 2.0E-08 |
| Benzo(a)Pyrene | 0.235040688 | 7.5213E-06 | 1.1E-06 | 71 | 1.5E-08 |
| Benzo(b)Fluoranthene | 0.229120909 | 7.33187E-06 | 1.0E-06 | 71 | 1.4E-08 |
| Benzo(g,h,i)Perylene | 0.125041613 | 4.00133E-06 | 5.6E-07 | 71 | 7.9E-09 |
| Benzo(k)Fluoranthene | 0.197122963 | 6.30793E-06 | 8.8E-07 | 71 | 1.2E-08 |
| Benzoic Acid | 0.24 | 7.6157E-06 | 1.1E-06 | | |
| Butylbenzylphthalate | 0.119146212 | 3.81268E-06 | 5.3E-07 | 7 | 7.6E-08 |
| Chrysene | 0.401210309 | 1.28387E-05 | 1.8E-06 | 71 | 2.5E-08 |
| Di-n-butylphthalate | 0.150027126 | 4.80087E-06 | 6.7E-07 | 7 | 9.6E-08 |
| Di-n-octylphthalate | 0.066453166 | 2.1265E-06 | 3.0E-07 | 7 | 4.2E-08 |
| Dibenzofuran | 0.069438498 | 2.22203E-06 | 3.1E-07 | | |
| Diethylphthalate | 0.033177641 | 1.06168E-06 | 1.5E-07 | 7 | 2.1E-08 |
| Fluoranthene | 0.841264099 | 2.69205E-05 | 3.8E-06 | 71 | 5.3E-08 |
| Fluorene | 0.644011598 | 2.06084E-05 | 2.9E-06 | 71 | 4.1E-08 |
| Indeno (1,2,3-cd)Pyrene | 0.120731463 | 3.86341E-06 | 5.4E-07 | 71 | 7.6E-09 |
| N-Nitrosodiphenylamine | 1.0 | 3.0673E-05 | 4.3E-06 | | |
| Naphthalene | 0.868425164 | 2.77896E-05 | 3.9E-06 | 71 | 5.5E-08 |
| Phenanthrene | 1.713341869 | 5.48269E-05 | 7.7E-06 | 71 | 1.1E-07 |
| Phenol | 0.114741 | 3.67171E-06 | 5.1E-07 | 260 | 2.0E-09 |
| Pyrene | 0.675631496 | 2.16202E-05 | 3.0E-06 | 71 | 4.3E-08 |
| bis(2-EthylHexyl)phthalate | 36.78097434 | 0.001176991 | 1.6E-04 | 7 | 2.3E-05 |
| 4,4'-DDD | 0.013111998 | 4.19584E-07 | 5.9E-08 | | |
| 4,4'-DDE | 0.014614968 | 4.67679E-07 | 6.5E-08 | | |
| 4,4'-DDT | 0.096166259 | 3.07732E-06 | 4.3E-07 | | |

ABB-Environmental Services, Inc.
MWSINALF.XLS
6/18/97

MWSINALF
INHALATION EXPOSURE TO OHM IN SURFACE SOIL PARTICULATES - ENTIRE SITE (EXCLUDING SULFATE LANDFILL)
RECEPTOR: FULL-TIME, LONG-TERM ON-SITE WORKER (PLANT B AREA AND MAINTENANCE ) - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A6-14

18-Jun-97

NONCARCINOGENIC EFFECTS

| COMPOUND | OHM SOIL CONCENTRATION mg/kg | OHM AIR CONCENTRATION (mg/m³) | AVERAGE AIR CONCENTRATION FOR TIME PERIOD (mg/m3) | CHRONIC INHALATION RfC [1] (mg/m3) | HAZARD QUOTIENT |
|---|---|---|---|---|---|
| Aldrin | 0.000723725 | 2.31592E-08 | 3.2E-09 | | |
| Alpha-BHC | 0.001439505 | 4.60641E-08 | 6.4E-09 | 0.7 | 9.2E-09 |
| Alpha-Chlordane | 0.000397946 | 1.27343E-08 | 1.8E-09 | 0.7 | 2.5E-09 |
| Dieldrin | 0.000410428 | 1.31337E-08 | 1.8E-09 | | |
| Endosulfan I | 0.000718312 | 2.2986E-08 | 3.2E-09 | | |
| Endosulfan II | 0.00353234 | 1.13035E-07 | 1.6E-08 | | |
| Endrin | 0.001643931 | 5.26058E-08 | 7.4E-09 | | |
| Endrin Ketone | 0.000442317 | 1.41541E-08 | 2.0E-09 | | |
| Gamma-BHC (Lindane) | 0.006027576 | 1.92882E-07 | 2.7E-08 | 0.7 | 3.9E-08 |
| Gamma-Chlordane | 0.001246558 | 3.98899E-08 | 5.6E-09 | 0.7 | 8.0E-09 |
| Heptachlor | 0.000019604 | 6.27328E-10 | 8.8E-11 | 0.7 | 1.3E-10 |
| Heptachlor Epoxide | 0.000111338 | 3.5628E-09 | 5.0E-10 | 0.7 | 7.1E-10 |
| PCB-1016 | 0.0156408 | 5.00506E-07 | 7.0E-08 | 0.02 | 3.5E-06 |
| Aluminum | 5,353 | 0.171308289 | 2.4E-02 | | |
| Antimony | 1.576214112 | 5.04389E-05 | 7.0E-06 | 10 | 7.0E-07 |
| Arsenic | 8.949406915 | 0.000286381 | 4.0E-05 | 0.0025 | 1.6E-02 |
| Barium | 20.63628698 | 0.000660361 | 9.2E-05 | 0.5 | 1.8E-04 |
| Beryllium | 0.037884618 | 1.21231E-06 | 1.7E-07 | 0.005 | 3.4E-05 |
| Cadmium | 0.4091042 | 1.30913E-05 | 1.8E-06 | 0.2 | 9.1E-06 |
| Calcium | 1,471 | 0.0470578 | 6.6E-03 | | |
| Chromium III | 125.0194879 | 0.004000624 | 5.6E-04 | 6.8 | 8.2E-05 |
| Chromium VI | 13.89105421 | 0.000444514 | 6.2E-05 | 0.02 | 3.1E-03 |
| Cobalt | 2.889568709 | 9.24662E-05 | 1.3E-05 | | |
| Cyanide | 0.202692 | 6.48614E-06 | 9.1E-07 | 1 | 9.1E-07 |
| Iron | 8,016 | 0.256499285 | 3.6E-02 | | |
| Lead | 43.48869863 | 0.001391638 | 1.9E-04 | 0.7 | 2.8E-04 |
| Manganese | 83.4918863 | 0.00267174 | 3.7E-04 | 0.05 | 7.5E-03 |
| Mercury | 0.114384115 | 3.66029E-06 | 5.1E-07 | 0.3 | 1.7E-06 |
| Nickel | 7.743232825 | 0.000247783 | 3.5E-05 | 0.009 | 3.8E-03 |
| Selenium | 0.553873945 | 1.7724E-05 | 2.5E-06 | 2.7 | 9.2E-07 |
| Sodium | 58.9900546 | 0.001887682 | 2.6E-04 | | |
| Thallium | 0.469300628 | 1.50176E-05 | 2.1E-06 | | |
| Vanadium | 16.58144156 | 0.000530606 | 7.4E-05 | 1.4 | 5.3E-05 |
| Zinc | 41.88665588 | 0.001340373 | 1.9E-04 | | |
| Chloride | 44.1126819 | 0.001411606 | 2.0E-04 | | |
| Nitrogen, Ammonia | 62.87137744 | 0.002011884 | 2.8E-04 | 100 | 2.8E-06 |
| Sulfate as SO4 | 1,227 | 0.039253618 | 5.5E-03 | | |
| | | | SUMMARY HAZARD INDEX | | 3E-02 |

ND = No data available.

ATTACHMENT 7

# ATTACHMENT 7

# SUBSURFACE SOIL RISK CALCULATION SPREADSHEETS

UWSBIDAL
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SUBSURFACE SOIL - ENTIRE SITE (EXLUDING SULFATE LANDFILL)
RECEPTOR: UTILITY WORKER - CURRENT AND FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A7-1

22-May-97

EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| CONCENTRATION SOIL | $[OHM]_{soil}$ | chemical specific | chemical-specific | |
| INGESTION RATE | IR | 500 | mg-soil/day | MADEP, 1995 |
| ADHERENCE FACTOR | AF | 0.51 | mg-soil/cm²-skin | MADEP, 1995 |
| AVERAGE SURFACE AREA (1) | SA | 5,200 | cm²/day | calculated per MADEP, 1995 |
| RELATIVE ABSORPTION FACTOR-ORAL | RAF-O | chemical specific | unitless | MADEP, 1994, 1995 |
| RELATIVE ABSORPTION FACTOR -DERM | RAF-D | chemical specific | unitless | MADEP, 1994, 1995 |
| CONVERSION FACTOR | CF | 1.00E-06 | kg/mg | |
| BODY WEIGHT | BW | 70 | kg | USEPA, 1989 |
| EXPOSURE PERIOD (2) | EP | 2.74E-02 | years | Assumption |
| EXPOSURE FREQUENCY (2) | EF | 10 | events/year | Assumption |
| EXPOSURE DURATION | ED | 1 | day/event | Assumption |
| AVERAGING PERIOD | | | | |
| CANCER | AP | 75 | years | MADEP, 1995 |
| NONCANCER | AP | 2.74E-02 | years | Assumption |

(1) 50th percentile of surface areas for males: heads, hands, arms.
(2) 5 days per week for 2 weeks.

MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
MADEP, 1995. Guidance for Disposal Site Risk Characterization. Interim Final Policy WSC/ORS-95-141. July 1995.
USEPA, 1989. Exposure Factors Handbook EPA/600/8-89/043. May 1989

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)^-1

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE-INGESTION} = \frac{[OHM]soil \times IR \times RAF\text{-}O \times CF \times EF \times ED \times EP}{BW \times AP \times 365\ days/yr}$$

$$\text{INTAKE-DERMAL} = \frac{[OHM]soil \times SA \times AF \times RAF\text{-}D \times EF \times ED \times EP \times CF}{BW \times AP \times 365\ days/yr}$$

UWSBIDAL
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SUBSURFACE SOIL - ENTIRE SITE (EXLUDING SULFATE LANDFILL)
RECEPTOR: UTILITY WORKER - CURRENT AND FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A7-1

22-May-97

CARCINOGENIC EFFECTS

| | SOIL CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | CANCER SLOPE FACTOR (mg/kg-day)^-1 | CANCER RISK INGESTION | CANCER RISK DERMAL | TOTAL CANCER RISK |
|---|---|---|---|---|---|---|---|---|---|
| 1,2-Dichloroethane | 0.0021 | 1.00 | 1.5E-13 | 0.10 | 7.9E-14 | 9.1E-02 | 1.4E-14 | 7.2E-15 | 2.1E-14 |
| Benzene | 0.0161 | 1.00 | 1.2E-12 | 0.08 | 4.9E-13 | 2.9E-02 | 3.3E-14 | 1.4E-14 | 4.8E-14 |
| Carbon Tetrachloride | 0.0002 | 1.00 | 1.4E-14 | 0.10 | 7.6E-15 | 1.3E-01 | 1.9E-15 | 9.9E-16 | 2.9E-15 |
| Chloroform | 0.0012 | 1.00 | 8.3E-14 | 0.10 | 4.4E-14 | 6.1E-03 | 5.1E-16 | 2.7E-16 | 7.8E-16 |
| Methylene Chloride | 0.0328 | 1.00 | 2.3E-12 | 0.10 | 1.2E-12 | 7.5E-03 | 1.8E-14 | 9.3E-15 | 2.7E-14 |
| Tetrachloroethene (PCE) | 0.0012 | 1.00 | 8.3E-14 | 0.10 | 4.4E-14 | 5.1E-02 | 4.2E-15 | 2.2E-15 | 6.4E-15 |
| Trichloroethene (TCE) | 0.0041 | 1.00 | 2.9E-13 | 0.10 | 1.5E-13 | 1.5E-02 | 4.4E-15 | 2.3E-15 | 6.7E-15 |
| 1,4-Dichlorobenzene | 0.0346 | 1.00 | 2.5E-12 | 0.10 | 1.3E-12 | 2.4E-02 | 5.9E-14 | 3.1E-14 | 9.1E-14 |
| 2-Methylphenol (o-Cresol) | 0.0338 | | | | | ND | | | |
| 4-Methylphenol(p-Cresol) | 0.0391 | | | | | ND | | | |
| Benzo(a)Anthracene | 0.0489 | 1.00 | 3.5E-12 | 0.20 | 3.7E-12 | 7.3E-01 | 2.6E-12 | 2.7E-12 | 5.3E-12 |
| Benzo(a)Pyrene | 0.0061 | 1.00 | 4.3E-13 | 0.20 | 4.6E-13 | 7.3E+00 | 3.2E-12 | 3.3E-12 | 6.5E-12 |
| Benzo(b)Fluoranthene | 0.0501 | 1.00 | 3.6E-12 | 0.20 | 3.8E-12 | 7.3E-01 | 2.6E-12 | 2.8E-12 | 5.4E-12 |
| Butylbenzylphthalate | 0.1535 | | | | | ND | | | |
| Chrysene | 0.1054 | 1.00 | 7.5E-12 | 0.20 | 8.0E-12 | 7.3E-03 | 5.5E-14 | 5.8E-14 | 1.1E-13 |
| Hexachlorobenzene | 0.0058 | 1.00 | 4.1E-13 | 0.13 | 2.8E-13 | 1.6E+00 | 6.6E-13 | 4.5E-13 | 1.1E-12 |
| Indeno (1,2,3-cd)Pyrene | 0.1334 | 1.00 | 9.5E-12 | 0.20 | 1.0E-11 | 7.3E-01 | 7.0E-12 | 7.4E-12 | 1.4E-11 |
| Isophorone | 0.0342 | 1.00 | 2.4E-12 | 0.19 | 2.4E-12 | 9.5E-04 | 2.3E-15 | 2.3E-15 | 4.6E-15 |
| N-Nitroso-di-n-propylamine | 0.3619 | 0.91 | 2.4E-11 | 0.17 | 2.3E-11 | 7.0E+00 | 1.6E-10 | 1.6E-10 | 3.3E-10 |
| N-Nitrosodiphenylamine | 109.0173 | 0.91 | 7.1E-09 | 0.17 | 7.0E-09 | 4.9E-03 | 3.5E-11 | 3.4E-11 | 6.9E-11 |
| bis(2-EthylHexyl)phthalate | 44.7304 | 1.00 | 3.2E-09 | 0.02 | 3.4E-10 | 1.4E-02 | 4.5E-11 | 4.7E-12 | 5.0E-11 |
| 4,4'-DDD | 0.0005 | 1.00 | 3.8E-14 | 0.20 | 4.0E-14 | 2.4E-01 | 9.0E-15 | 9.6E-15 | 1.9E-14 |
| Aldrin | 0.0003 | 1.00 | 2.2E-14 | 0.25 | 2.9E-14 | 1.7E+01 | 3.7E-13 | 4.9E-13 | 8.5E-13 |
| Alpha-BHC | 0.0003 | 0.96 | 1.9E-14 | 0.18 | 1.9E-14 | 6.3E+00 | 1.2E-13 | 1.2E-13 | 2.4E-13 |
| Alpha-Chlordane | 0.0230 | 1.00 | 1.6E-12 | 0.05 | 4.4E-13 | 1.3E+00 | 2.1E-12 | 5.7E-13 | 2.7E-12 |
| Gamma-BHC (Lindane) | 0.0014 | 1.00 | 1.0E-13 | 0.20 | 1.1E-13 | 1.3E+00 | 1.3E-13 | 1.4E-13 | 2.7E-13 |
| Toxaphene | 0.0460 | 0.96 | 3.1E-12 | 0.18 | 3.1E-12 | 1.1E+00 | 3.5E-12 | 3.4E-12 | 6.9E-12 |
| Arsenic | 6.0187 | 1.00 | 4.3E-10 | 0.03 | 6.8E-11 | 1.5E+00 | 6.5E-10 | 1.0E-10 | 7.5E-10 |
| Cadmium | 0.6359 | | | | | ND | | | |
| | | | | | SUMMARY CANCER RISK | | 9E-10 | 3E-10 | 1E-09 |

[1] MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
ND = no data available

UWSBIDAL
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SUBSURFACE SOIL - ENTIRE SITE (EXLUDING SULFATE LANDFILL)
RECEPTOR: UTILITY WORKER - CURRENT AND FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A7-1

22-May-97

NONCARCINOGENIC EFFECTS

| COMPOUND | SOIL CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | SUBCHRONIC RfD (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|
| 1,2-Dichloroethane | 0.0021 | 1.00 | 4.1E-10 | 0.10 | 2.2E-10 | 2.0E-02 | 2.0E-08 | 1.1E-08 | 3.1E-08 |
| 2,4,4-Trimethyl-1-pentene | 3.9307 | 0.99 | 7.6E-07 | 0.11 | 4.5E-07 | 2.1E-01 | 3.7E-06 | 2.2E-06 | 5.9E-06 |
| 2,4,4-Trimethyl-2-Pentene | 1.5589 | 0.99 | 3.0E-07 | 0.11 | 1.8E-07 | 2.1E-01 | 1.5E-06 | 8.7E-07 | 2.3E-06 |
| 2-Butanone (MEK) | 0.0142 | 1.00 | 2.8E-09 | 0.10 | 1.5E-09 | 2.0E+00 | 1.4E-09 | 7.3E-10 | 2.1E-09 |
| 2-Hexanone | 0.1762 | 1.00 | 3.4E-08 | 0.10 | 1.8E-08 | 2.0E+00 | 1.7E-08 | 9.1E-09 | 2.6E-08 |
| 4-Methyl-2-Pentanone (MIBK) | 0.0290 | 1.00 | 5.7E-09 | 0.10 | 3.0E-09 | 8.0E-01 | 7.1E-09 | 3.8E-09 | 1.1E-08 |
| Acetone | 2.3008 | 1.00 | 4.5E-07 | 0.10 | 2.4E-07 | 1.0E+00 | 4.5E-07 | 2.4E-07 | 6.9E-07 |
| Benzene | 0.0161 | 1.00 | 3.2E-09 | 0.08 | 1.3E-09 | 5.0E-02 | 6.3E-08 | 2.7E-08 | 9.0E-08 |
| Carbon Disulfide | 0.0149 | 1.09 | 3.2E-09 | 0.12 | 1.9E-09 | 1.0E-01 | 3.2E-08 | 1.9E-08 | 5.0E-08 |
| Carbon Tetrachloride | 0.0002 | 1.00 | 3.9E-11 | 0.10 | 2.1E-11 | 7.0E-04 | 5.6E-08 | 3.0E-08 | 8.6E-08 |
| Chlorobenzene | 0.0049 | 1.00 | 9.7E-10 | 0.10 | 5.1E-10 | 2.0E-01 | 4.8E-09 | 2.6E-09 | 7.4E-09 |
| Chloroform | 0.0012 | 1.00 | 2.3E-10 | 0.10 | 1.2E-10 | 1.0E-02 | 2.3E-08 | 1.2E-08 | 3.5E-08 |
| Ethylbenzene | 0.0944 | 1.00 | 1.8E-08 | 0.20 | 2.0E-08 | 1.0E+00 | 1.8E-08 | 2.0E-08 | 3.8E-08 |
| Methylene Chloride | 0.0328 | 1.00 | 6.4E-09 | 0.10 | 3.4E-09 | 6.0E-02 | 1.1E-07 | 5.7E-08 | 1.6E-07 |
| Styrene | 0.1243 | 1.00 | 2.4E-08 | 0.20 | 2.6E-08 | 2.0E+00 | 1.2E-08 | 1.3E-08 | 2.5E-08 |
| Tetrachloroethene (PCE) | 0.0012 | 1.00 | 2.3E-10 | 0.10 | 1.2E-10 | 1.0E-01 | 2.3E-09 | 1.2E-09 | 3.5E-09 |
| Toluene | 0.2352 | 1.00 | 4.6E-08 | 0.12 | 2.9E-08 | 2.0E+00 | 2.3E-08 | 1.5E-08 | 3.8E-08 |
| Trichloroethene (TCE) | 0.0041 | 1.00 | 8.0E-10 | 0.10 | 4.2E-10 | 2.0E-02 | 4.0E-08 | 2.1E-08 | 6.1E-08 |
| Xylenes, Total | 0.0170 | 1.00 | 3.3E-09 | 0.12 | 2.1E-09 | 4.0E+00 | 8.3E-10 | 5.3E-10 | 1.4E-09 |
| 1,2,3-Trichlorobenzene | 0.0125 | 1.00 | 2.4E-09 | 0.08 | 1.0E-09 | 1.0E-02 | 2.4E-07 | 1.0E-07 | 3.5E-07 |
| 1,2,4-Trichlorobenzene | 0.0235 | 1.00 | 4.6E-09 | 0.08 | 1.9E-09 | 1.0E-02 | 4.6E-07 | 1.9E-07 | 6.5E-07 |
| 1,2-Dichlorobenzene | 0.0296 | 1.00 | 5.8E-09 | 0.10 | 3.1E-09 | 9.0E-01 | 6.4E-09 | 3.4E-09 | 9.9E-09 |
| 1,3-Dichlorobenzene | 0.0070 | 0.96 | 1.3E-09 | 0.18 | 1.3E-09 | 9.0E-01 | 1.5E-09 | 1.4E-09 | 2.9E-09 |
| 1,4-Dichlorobenzene | 0.0346 | 0.96 | 6.5E-09 | 0.18 | 6.5E-09 | 9.0E-01 | 7.2E-09 | 7.2E-09 | 1.4E-08 |
| 2,4-Dimethylphenol | 0.0145 | 1.00 | 2.8E-09 | 0.26 | 3.9E-09 | 2.0E-01 | 1.4E-08 | 2.0E-08 | 3.4E-08 |
| 2-Methylnaphthalene | 0.0015 | 1.00 | 3.0E-10 | 0.20 | 3.1E-10 | 3.0E-02 | 9.9E-09 | 1.0E-08 | 2.0E-08 |
| 2-Methylphenol (o-Cresol) | 0.0338 | 1.00 | 6.6E-09 | 0.19 | 6.6E-09 | 5.0E-01 | 1.3E-08 | 1.3E-08 | 2.6E-08 |
| 4-Bromophenyl-phenylether | 0.0116 | | | | | | | | |
| 4-Chlorophenyl-phenylether | 0.0119 | | | | | | | | |
| 4-Methylphenol(p-Cresol) | 0.0391 | 1.00 | 7.6E-09 | 0.19 | 7.6E-09 | 5.0E-03 | 1.5E-06 | 1.5E-06 | 3 0E-06 |
| Anthracene | 0.0031 | 1.00 | 6.0E-10 | 0.29 | 9.3E-10 | 3.0E+00 | 2.0E-10 | 3.1E-10 | 5.1E-10 |
| Benzo(a)Anthracene | 0.0489 | 0.91 | 8.7E-09 | 0.18 | 9.1E-09 | 3.0E-02 | 2.9E-07 | 3.0E-07 | 6.0E-07 |
| Benzo(a)Pyrene | 0.0061 | 0.91 | 1.1E-09 | 0.18 | 1.1E-09 | 3.0E-02 | 3.6E-08 | 3.8E-08 | 7.4E-08 |
| Benzo(b)Fluoranthene | 0.0501 | 0.91 | 8.9E-09 | 0.18 | 9.4E-09 | 3.0E-02 | 3.0E-07 | 3.1E-07 | 6.1E-07 |
| Butylbenzylphthalate | 0.1535 | 0.96 | 2.9E-08 | 0.18 | 2.9E-08 | 2.0E+00 | 1.4E-08 | 1.4E-08 | 2.9E-08 |
| Chrysene | 0.1054 | 0.91 | 1.9E-08 | 0.18 | 2.0E-08 | 3.0E-02 | 6.3E-07 | 6.6E-07 | 1.3E-06 |
| Di-n-butylphthalate | 0.1539 | 0.96 | 2.9E-08 | 0.18 | 2.9E-08 | 1.0E+00 | 2.9E-08 | 2.9E-08 | 5.7E-08 |
| Di-n-octylphthalate | 0.2835 | 0.96 | 5.3E-08 | 0.18 | 5.3E-08 | 2.0E-02 | 2.7E-06 | 2.6E-06 | 5.3E-06 |
| Dibenzofuran | 0.0130 | 1.00 | 2.5E-09 | 0.19 | 2.5E-09 | 3.0E-02 | 8.4E-08 | 8.4E-08 | 1.7E-07 |
| Diethylphthalate | 0.0462 | 1.00 | 9.0E-09 | 0.02 | 9.6E-10 | 8.0E+00 | 1.1E-09 | 1.2E-10 | 1.2E-09 |
| Fluoranthene | 0.0196 | 1.00 | 3.8E-09 | 0.20 | 4.1E-09 | 4.0E-01 | 9.6E-09 | 1.0E-08 | 2.0E-08 |

UWSBIDAL
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SUBSURFACE SOIL - ENTIRE SITE (EXLUDING SULFATE LANDFILL)
*RECEPTOR: UTILITY WORKER - CURRENT AND FUTURE LAND USE*
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A7-1

22-May-97

NONCARCINOGENIC EFFECTS

| COMPOUND | SOIL CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | SUBCHRONIC RfD (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|
| Hexachlorobenzene | 0.0058 | 1.00 | 1.1E-09 | 0.13 | 7.8E-10 | 8.0E-04 | 1.4E-06 | 9.7E-07 | 2.4E-06 |
| Indeno (1,2,3-cd)Pyrene | 0.1334 | 0.91 | 2.4E-08 | 0.18 | 2.5E-08 | 3.0E-02 | 7.9E-07 | 8.3E-07 | 1.6E-06 |
| Isophorone | 0.0342 | 1.00 | 6.7E-09 | 0.19 | 6.6E-09 | 2.0E+00 | 3.3E-09 | 3.3E-09 | 6.7E-09 |
| N-Nitroso-di-n-propylamine | 0.3619 | 0.91 | 6.4E-08 | 0.17 | 6.4E-08 | 9.5E-02 | 6.8E-07 | 6.7E-07 | 1.4E-06 |
| N-Nitrosodiphenylamine | 109.0173 | 0.96 | 2.0E-05 | 0.18 | 2.0E-05 | 5.0E-02 | 4.1E-04 | 4.0E-04 | 8.1E-04 |
| Naphthalene | 0.0834 | 1.00 | 1.6E-08 | 0.10 | 8.7E-09 | 4.0E-02 | 4.1E-07 | 2.2E-07 | 6.2E-07 |
| Phenanthrene | 0.0212 | 0.91 | 3.8E-09 | 0.18 | 4.0E-09 | 3.0E-02 | 1.3E-07 | 1.3E-07 | 2.6E-07 |
| Phenol | 2.0707 | 1.00 | 4.1E-07 | 0.26 | 5.6E-07 | 6.0E-01 | 6.8E-07 | 9.3E-07 | 1.6E-06 |
| Pyrene | 0.1610 | 1.00 | 3.2E-08 | 0.20 | 3.3E-08 | 3.0E-01 | 1.1E-07 | 1.1E-07 | 2.2E-07 |
| bis(2-EthylHexyl)phthalate | 44.7304 | 1.00 | 8.8E-06 | 0.02 | 9.3E-07 | 2.0E-02 | 4.4E-04 | 4.6E-05 | 4.8E-04 |
| 4,4'-DDD | 0.0005 | 0.96 | 9.9E-11 | 0.18 | 9.8E-11 | 5.0E-04 | 2.0E-07 | 2.0E-07 | 3.9E-07 |
| Aldrin | 0.0003 | 1.00 | 5.9E-11 | 0.25 | 7.8E-11 | 3.0E-05 | 2.0E-06 | 2.6E-06 | 4.6E-06 |
| Alpha-BHC | 0.0003 | 0.96 | 5.2E-11 | 0.18 | 5.1E-11 | 5.0E-04 | 1.0E-07 | 1.0E-07 | 2.1E-07 |
| Alpha-Chlordane | 0.0230 | 1.00 | 4.5E-09 | 0.05 | 1.2E-09 | 6.0E-05 | 7.5E-05 | 2.0E-05 | 9.5E-05 |
| Endosulfan I | 0.0002 | 0.96 | 3.6E-11 | 0.18 | 3.5E-11 | 6.0E-03 | 5.9E-09 | 5.9E-09 | 1.2E-08 |
| Endosulfan Sulfate | 0.0009 | 0.96 | 1.7E-10 | 0.18 | 1.7E-10 | 6.0E-03 | 2.8E-08 | 2.8E-08 | 5.6E-08 |
| Endrin | 0.0007 | 1.00 | 1.4E-10 | 0.25 | 1.8E-10 | 3.0E-04 | 4.5E-07 | 6.0E-07 | 1.1E-06 |
| Endrin Ketone | 0.0022 | 0.96 | 4.2E-10 | 0.18 | 4.2E-10 | 3.0E-04 | 1.4E-06 | 1.4E-06 | 2.8E-06 |
| Gamma-BHC (Lindane) | 0.0014 | 1.00 | 2.8E-10 | 0.20 | 2.9E-10 | 3.0E-03 | 9.3E-08 | 9.8E-08 | 1.9E-07 |
| Methoxychlor | 0.0230 | 1.00 | 4.5E-09 | 0.20 | 4.8E-09 | 5.0E-03 | 9.0E-07 | 9.5E-07 | 1.9E-06 |
| Toxaphene | 0.0458 | 0.96 | 8.6E-09 | 0.18 | 8.5E-09 | 5.0E-05 | 1.7E-04 | 1.7E-04 | 3.4E-04 |
| Antimony | 0.2226 | 1.00 | 4.4E-08 | 0.10 | 2.3E-08 | 4.0E-04 | 1.1E-04 | 5.8E-05 | 1.7E-04 |
| Arsenic | 6.0187 | 1.00 | 1.2E-06 | 0.03 | 1.9E-07 | 3.0E-04 | 3.9E-03 | 6.2E-04 | 4.6E-03 |
| Barium | 17.4645 | 0.71 | 2.4E-06 | 0.05 | 9.9E-07 | 7.0E-02 | 3.5E-05 | 1.4E-05 | 4.9E-05 |
| Cadmium | 0.6359 | 1.00 | 1.2E-07 | 0.14 | 9.2E-08 | 5.0E-04 | 2.5E-04 | 1.8E-04 | 4.3E-04 |
| Calcium | 1466.2349 | | | | | | | | |
| Chromium III | 76.8600 | 1.00 | 1.5E-05 | 0.04 | 3.2E-06 | 1.0E+00 | 1.5E-05 | 3.2E-06 | 1.8E-05 |
| Cobalt | 2.2048 | 1.86 | 8.0E-07 | 0.14 | 3.3E-07 | 6.0E-02 | 1.3E-05 | 5.4E-06 | 1.9E-05 |
| Copper | 6.1031 | | | | | | | | |
| Cyanide | 0.0480 | 1.00 | 9.4E-09 | 0.30 | 1.5E-08 | 2.0E-02 | 4.7E-07 | 7.5E-07 | 1.2E-06 |
| Iron | 6740.3518 | | | | | | | | |
| Manganese | 79.5508 | 1.86 | 2.9E-05 | 0.14 | 1.2E-05 | 4.7E-02 | 6.2E-04 | 2.5E-04 | 8.7E-04 |
| Mercury | 0.0032 | 1.00 | 6.2E-10 | 0.05 | 1.6E-10 | 3.0E-04 | 2.1E-06 | 5.5E-07 | 2.6E-06 |
| Nickel | 5.8979 | 1.00 | 1.2E-06 | 0.35 | 2.1E-06 | 2.0E-02 | 5.8E-05 | 1.1E-04 | 1.6E-04 |
| Potassium | 772.9860 | | | | | | | | |
| Silver | 0.7425 | 1.00 | 1.5E-07 | 0.25 | 1.9E-07 | 5.0E-03 | 2.9E-05 | 3.9E-05 | 6.8E-05 |
| Sodium | 117.7923 | | | | | | | | |
| Vanadium | 2.2380 | 0.71 | 3.1E-07 | 0.05 | 1.3E-07 | 7.0E-03 | 4.4E-05 | 1.8E-05 | 6.2E-05 |
| Chloride | 43.2578 | | | | | | | | |
| Nitrogen, Ammonia | 69.5017 | 0.71 | 9.6E-06 | 0.05 | 3.9E-06 | 3.7E-01 | 2.6E-05 | 1.1E-05 | 3.7E-05 |
| Sulfate as SO4 | 940.9124 | | | | | | | | |
| Chromium VI | 8.54 | 1.00 | 1.7E-06 | 0.09 | 8.0E-07 | 2.0E-02 | 8.4E-05 | 4.0E-05 | 1.2E-04 |
| | | | | | | SUMMARY HAZARD INDEX | 6E-03 | 2E-03 | 8E-03 |

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UWSBINAL
INHALATION EXPOSURE TO OHM IN SUBSURFACE SOIL PARTICULATES - ENTIRE SITE (EXCLUDING SULFATE LANDFILL)
RECEPTOR: UTILITY WORKER - CURRENT AND FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A7-2

22-May-97

EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| CONCENTRATION IN AIR | [RP]air | 60 | ug/m3 | MADEP, 1995 |
| CONCENTRATION IN SOIL | [OHM]part | chemical-specific | mg/kg | |
| CONVERSION FACTOR 1 | CF1 | 24 | hours/day | |
| EXPOSURE TIME DAILY | ET | 8 | hours/day | Assumption |
| EXPOSURE FREQUENCY (1) | EF | 10 | days/year | Assumption |
| EXPOSURE DURATION (1) | ED | 0.0274 | years | Assumption |
| CONVERSION FACTOR 2 | CF2 | 365 | days/year | |
| CONVERSION FACTOR 3 | CF3 | 0.000001 | kg/mg | |
| AVERAGING TIME CANCER | AT | 75 | years | MADEP, 1995 |
| AVERAGING TIME NONCANCER | AT | 0.0274 | years | Assumption |

(1) 5 days per week for 2weeks.
MADEP, 1995. Guidance for Disposal Site Risk Characterization, Interim Final Policy WSC/ORS-95-141. July.

EQUATIONS

CANCER RISK = AVG. CONC. (ug/m3) * CANCER UNIT RISK (ug/m3)^-1

HAZARD QUOTIENT = AVG.CONC.(ug/m3)/REF. CONC. (ug/m3)

AVG. EXPOSURE CONC. = $\frac{\text{[OHM]air * EF * ET * ED}}{\text{AT * CF1 * CF2}}$

OHM AIR CONC. = [RP]air * [OHM]part * CF3

Note:
*For noncarcinogenic effects: AT = ED

UWSBINAL
INHALATION EXPOSURE TO OHM IN SUBSURFACE SOIL PARTICULATES - ENTIRE SITE (EXCLUDING SULFATE LANDFILL)
RECEPTOR: UTILITY WORKER - CURRENT AND FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A7-2

22-May-97
CARCINOGENIC EFFECTS

| COMPOUND | OHM SOIL CONCENTRATION (mg/kg) | OHM AIR CONCENTRATION (ug/m3) | AVERAGE AIR CONCENTRATION LIFETIME (ug/m3) | INHALATION CANCER UNIT RISK (ug/m3)^-1 | CANCER RISK |
|---|---|---|---|---|---|
| 1,2-Dichloroethane | 0.0021 | 1.2564E-07 | 4.2E-13 | 2.6E-05 | 1.1E-17 |
| Benzene | 0.0161 | 9.6864E-07 | 3.2E-12 | 8.3E-06 | 2.7E-17 |
| Carbon Tetrachloride | 0.0002 | 1.206E-08 | 4.0E-14 | 1.5E-05 | 6.0E-19 |
| Chloroform | 0.0012 | 7.008E-08 | 2.3E-13 | 2.3E-05 | 5.4E-18 |
| Methylene Chloride | 0.0328 | 1.96896E-06 | 6.6E-12 | 4.7E-07 | 3.1E-18 |
| Tetrachloroethene (PCE) | 0.0012 | 6.9276E-08 | 2.3E-13 | 5.9E-06 | 1.4E-18 |
| Trichloroethene (TCE) | 0.0041 | 2.4396E-07 | 8.1E-13 | 2.0E-06 | 1.6E-18 |
| 1,4-Dichlorobenzene | 0.0346 | 2.07464E-06 | 6.9E-12 | 1.1E-05 | 7.6E-17 |
| 2-Methylphenol (o-Cresol) | 0.0338 | 2.0292E-06 | 6.8E-12 | | |
| 4-Methylphenol(p-Cresol) | 0.0391 | 2.34408E-06 | 7.8E-12 | | |
| Benzo(a)Anthracene | 0.0489 | 2.93568E-06 | 9.8E-12 | 1.1E-04 | 1.1E-15 |
| Benzo(a)Pyrene | 0.0061 | 0.000000363 | 1.2E-12 | 1.1E-03 | 1.3E-15 |
| Benzo(b)Fluoranthene | 0.0501 | 3.00636E-06 | 1.0E-11 | 1.1E-04 | 1.1E-15 |
| Butylbenzylphthalate | 0.1535 | 9.21199E-06 | 3.1E-11 | | |
| Chrysene | 0.1054 | 6.32298E-06 | 2.1E-11 | 1.1E-06 | 2.3E-17 |
| Hexachlorobenzene | 0.0058 | 3.456E-07 | 1.2E-12 | 4.6E-04 | 5.3E-16 |
| Indeno (1,2,3-cd)Pyrene | 0.1334 | 8.0064E-06 | 2.7E-11 | 1.1E-04 | 2.9E-15 |
| Isophorone | 0.0342 | 2.0538E-06 | 6.9E-12 | | |
| N-Nitroso-di-n-propylamine | 0.3619 | 2.17145E-05 | 7.2E-11 | 2.0E-03 | 1.4E-13 |
| N-Nitrosodiphenylamine | 109.0173 | 0.006541041 | 2.2E-08 | 2.6E-06 | 5.7E-14 |
| bis(2-EthylHexyl)phthalate | 44.7304 | 0.002683823 | 9.0E-09 | 2.4E-06 | 2.1E-14 |
| 4,4'-DDD | 0.0005 | 3.1536E-08 | 1.1E-13 | 9.7E-05 | 1.0E-17 |
| Aldrin | 0.0003 | 1.8144E-08 | 6.1E-14 | 4.9E-03 | 3.0E-16 |
| Alpha-BHC | 0.0003 | 1.656E-08 | 5.5E-14 | 1.8E-03 | 9.9E-17 |
| Alpha-Chlordane | 0.0230 | 1.3797E-06 | 4.6E-12 | 3.7E-04 | 1.7E-15 |
| Gamma-BHC (Lindane) | 0.0014 | 8.514E-08 | 2.8E-13 | 1.8E-05 | 5.2E-18 |
| Toxaphene | 0.0460 | 2.75852E-06 | 9.2E-12 | 3.2E-04 | 2.9E-15 |
| Arsenic | 6.0187 | 0.000361123 | 1.2E-09 | 4.3E-03 | 5.2E-12 |
| Cadmium | 0.6359 | 3.81529E-05 | 1.3E-10 | 1.8E-03 | 2.3E-13 |
| Chromium VI | 8.54 | 0.0005124 | 1.7E-09 | 1.2E-02 | 2.1E-11 |
| Nickel | 5.8979 | 0.000353875 | 1.2E-09 | 2.4E-04 | 2.8E-13 |
| | | | SUMMARY CANCER RISK | | 3E-11 |

ND = No data available.

UWSBINAL
INHALATION EXPOSURE TO OHM IN SUBSURFACE SOIL PARTICULATES - ENTIRE SITE (EXCLUDING SULFATE LANDFILL)
RECEPTOR: UTILITY WORKER - CURRENT AND FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A7-2

22-May-97

| COMPOUND | OHM SOIL CONCENTRATION mg/kg | OHM AIR CONCENTRATION (ug/m3) | AVERAGE AIR CONCENTRATION FOR TIME PERIOD (ug/m3) | SUBCHRONIC INHALATION RfC [1] (ug/m3) | HAZARD QUOTIENT |
|---|---|---|---|---|---|
| 1,2-Dichloroethane | 0.0021 | 1.2564E-07 | 1.1E-09 | 5.5E+01 | 2.1E-11 |
| 2,4,4-Trimethyl-1-pentene | 3.9307 | 0.000235843 | 2.2E-06 | 7.2E+02 | 3.0E-09 |
| 2,4,4-Trimethyl-2-Pentene | 1.5589 | 9.35356E-05 | 8.5E-07 | 7.2E+02 | 1.2E-09 |
| 2-Butanone (MEK) | 0.0142 | 8.497E-07 | 7.8E-09 | 1.0E+03 | 7.8E-12 |
| 2-Hexanone | 0.1762 | 1.05717E-05 | 9.7E-08 | 5.0E+01 | 1.9E-09 |
| 4-Methyl-2-Pentanone (MIBK) | 0.0290 | 1.7385E-06 | 1.6E-08 | 8.0E+02 | 2.0E-11 |
| Acetone | 2.3008 | 0.000138048 | 1.3E-06 | 8.0E+02 | 1.6E-09 |
| Benzene | 0.0161 | 9.6864E-07 | 8.8E-09 | 3.2E+01 | 2.8E-10 |
| Carbon Disulfide | 0.0149 | 8.94168E-07 | 8.2E-09 | 1.0E+01 | 8.2E-10 |
| Carbon Tetrachloride | 0.0002 | 1.206E-08 | 1.1E-10 | 4.3E+02 | 2.6E-13 |
| Chlorobenzene | 0.0049 | 2.96034E-07 | 2.7E-09 | 2.0E+01 | 1.4E-10 |
| Chloroform | 0.0012 | 7.008E-08 | 6.4E-10 | 6.6E+02 | 9.7E-13 |
| Ethylbenzene | 0.0944 | 5.66111E-06 | 5.2E-08 | 1.0E+03 | 5.2E-11 |
| Methylene Chloride | 0.0328 | 1.96896E-06 | 1.8E-08 | 3.0E+03 | 6.0E-12 |
| Styrene | 0.1243 | 7.45938E-06 | 6.8E-08 | 3.0E+03 | 2.3E-11 |
| Tetrachloroethene (PCE) | 0.0012 | 6.9276E-08 | 6.3E-10 | 4.6E+03 | 1.4E-13 |
| Toluene | 0.2352 | 1.41097E-05 | 1.3E-07 | 4.0E+02 | 3.2E-10 |
| Trichloroethene (TCE) | 0.0041 | 2.4396E-07 | 2.2E-09 | 1.8E+02 | 1.2E-11 |
| Xylenes, Total | 0.0170 | 1.02175E-06 | 9.3E-09 | 3.0E+02 | 3.1E-11 |
| 1,2,3-Trichlorobenzene | 0.0125 | 7.476E-07 | 6.8E-09 | 2.0E+03 | 3.4E-12 |
| 1,2,4-Trichlorobenzene | 0.0235 | 1.40812E-06 | 1.3E-08 | 2.0E+03 | 6.4E-12 |
| 1,2-Dichlorobenzene | 0.0296 | 1.77692E-06 | 1.6E-08 | 2.0E+03 | 8.1E-12 |
| 1,3-Dichlorobenzene | 0.0070 | 4.176E-07 | 3.8E-09 | 2.0E+03 | 1.9E-12 |
| 1,4-Dichlorobenzene | 0.0346 | 2.07464E-06 | 1.9E-08 | 2.5E+03 | 7.6E-12 |
| 2,4-Dimethylphenol | 0.0145 | 8.7042E-07 | 7.9E-09 | | |
| 2-Methylnaphthalene | 0.0015 | 9.072E-08 | 8.3E-10 | 7.1E+01 | 1.2E-11 |
| 2-Methylphenol (o-Cresol) | 0.0338 | 2.0292E-06 | 1.9E-08 | 1.0E+02 | 1.9E-10 |
| 4-Bromophenyl-phenylether | 0.0116 | 6.948E-07 | 6.3E-09 | | |
| 4-Chlorophenyl-phenylether | 0.0119 | 7.16688E-07 | 6.5E-09 | | |
| 4-Methylphenol(p-Cresol) | 0.0391 | 2.34408E-06 | 2.1E-08 | 1.0E+02 | 2.1E-10 |
| Anthracene | 0.0031 | 1.848E-07 | 1.7E-09 | 7.1E+01 | 2.4E-11 |
| Benzo(a)Anthracene | 0.0489 | 2.93568E-06 | 2.7E-08 | 7.1E+01 | 3.8E-10 |
| Benzo(a)Pyrene | 0.0061 | 0.000000363 | 3.3E-09 | 7.1E+01 | 4.7E-11 |
| Benzo(b)Fluoranthene | 0.0501 | 3.00636E-06 | 2.7E-08 | 7.1E+01 | 3.9E-10 |
| Butylbenzylphthalate | 0.1535 | 9.21199E-06 | 8.4E-08 | 7.0E+00 | 1.2E-08 |
| Chrysene | 0.1054 | 6.32298E-06 | 5.8E-08 | 7.1E+01 | 8.1E-10 |
| Di-n-butylphthalate | 0.1539 | 9.2319E-06 | 8.4E-08 | 7.0E+00 | 1.2E-08 |
| Di-n-octylphthalate | 0.2835 | 1.701E-05 | 1.6E-07 | 7.0E+00 | 2.2E-08 |
| Dibenzofuran | 0.0130 | 7.7706E-07 | 7.1E-09 | | |
| Diethylphthalate | 0.0462 | 2.7702E-06 | 2.5E-08 | 7.0E+00 | 3.6E-09 |
| Fluoranthene | 0.0196 | 1.17408E-06 | 1.1E-08 | 7.1E+01 | 1.5E-10 |

**UWSBINAL**
**INHALATION EXPOSURE TO OHM IN SUBSURFACE SOIL PARTICULATES - ENTIRE SITE (EXCLUDING SULFATE LANDFILL)**
**RECEPTOR: UTILITY WORKER - CURRENT AND FUTURE LAND USE**
**OLIN CORPORATION**
**WILMINGTON, MA FACILITY**
**TABLE A7-2**

22-May-97

| COMPOUND | OHM SOIL CONCENTRATION mg/kg | OHM AIR CONCENTRATION (ug/m3) | AVERAGE AIR CONCENTRATION FOR TIME PERIOD (ug/m3) | SUBCHRONIC INHALATION RfC [1] (ug/m3) | HAZARD QUOTIENT |
|---|---|---|---|---|---|
| Hexachlorobenzene | 0.0058 | 3.456E-07 | 3.2E-09 | | |
| Indeno (1,2,3-cd)Pyrene | 0.1334 | 8.0064E-06 | 7.3E-08 | 7.1E+01 | 1.0E-09 |
| Isophorone | 0.0342 | 2.0538E-06 | 1.9E-08 | | |
| N-Nitroso-di-n-propylamine | 0.3619 | 2.17145E-05 | 2.0E-07 | | |
| N-Nitrosodiphenylamine | 109.0173 | 0.006541041 | 6.0E-05 | | |
| Naphthalene | 0.0834 | 5.00514E-06 | 4.6E-08 | 7.1E+01 | 6.4E-10 |
| Phenanthrene | 0.0212 | 1.27498E-06 | 1.2E-08 | 7.1E+01 | 1.6E-10 |
| Phenol | 2.0707 | 0.000124242 | 1.1E-06 | 2.6E+02 | 4.4E-09 |
| Pyrene | 0.1610 | 0.00000966 | 8.8E-08 | 7.1E+01 | 1.2E-09 |
| bis(2-EthylHexyl)phthalate | 44.7304 | 0.002683823 | 2.5E-05 | 7.0E+00 | 3.5E-06 |
| 4,4'-DDD | 0.0005 | 3.1536E-08 | 2.9E-10 | | |
| Aldrin | 0.0003 | 1.8144E-08 | 1.7E-10 | | |
| Alpha-BHC | 0.0003 | 1.656E-08 | 1.5E-10 | 7.0E-01 | 2.2E-10 |
| Alpha-Chlordane | 0.0230 | 1.3797E-06 | 1.3E-08 | 7.0E-01 | 1.8E-08 |
| Endosulfan I | 0.0002 | 1.13742E-08 | 1.0E-10 | | |
| Endosulfan Sulfate | 0.0009 | 5.4144E-08 | 4.9E-10 | | |
| Endrin | 0.0007 | 4.1616E-08 | 3.8E-10 | | |
| Endrin Ketone | 0.0022 | 1.3464E-07 | 1.2E-09 | | |
| Gamma-BHC (Lindane) | 0.0014 | 8.514E-08 | 7.8E-10 | 7.0E-01 | 1.1E-09 |
| Methoxychlor | 0.0230 | 1.3797E-06 | 1.3E-08 | | |
| Toxaphene | 0.0458 | 2.7468E-06 | 2.5E-08 | | |
| Antimony | 0.2226 | 1.33567E-05 | 1.2E-07 | 1.0E+01 | 1.2E-08 |
| Arsenic | 6.0187 | 0.000361123 | 3.3E-06 | 2.5E-03 | 1.3E-03 |
| Barium | 17.4645 | 0.00104787 | 9.6E-06 | 5.0E+00 | 1.9E-06 |
| Cadmium | 0.6359 | 3.81529E-05 | 3.5E-07 | 2.0E-01 | 1.7E-06 |
| Calcium | 1466.2349 | 0.087974094 | 8.0E-04 | | |
| Chromium III | 76.8600 | 0.0046116 | 4.2E-05 | 6.8E+00 | 6.2E-06 |
| Chromium VI | 8.5400 | 0.0005124 | 4.7E-06 | 2.0E-02 | 2.3E-04 |
| Cobalt | 2.2048 | 0.000132287 | 1.2E-06 | | |
| Copper | 6.1031 | 0.000366183 | 3.3E-06 | 2.7E+00 | 1.2E-06 |
| Cyanide | 0.0480 | 0.00000288 | 2.6E-08 | 7.0E+00 | 3.8E-09 |
| Iron | 6740.3518 | 0.404421108 | 3.7E-03 | | |
| Manganese | 79.5508 | 0.00477305 | 4.4E-05 | 5.0E-02 | 8.7E-04 |
| Mercury | 0.0032 | 1.89481E-07 | 1.7E-09 | 3.0E-01 | 5.8E-09 |
| Nickel | 5.8979 | 0.000353875 | 3.2E-06 | 9.0E-03 | 3.6E-04 |
| Potassium | 772.9860 | 0.046379158 | 4.2E-04 | | |
| Silver | 0.7425 | 4.45516E-05 | 4.1E-07 | | |
| Sodium | 117.7923 | 0.007067537 | 6.5E-05 | | |
| Vanadium | 2.2380 | 0.000134279 | 1.2E-06 | 6.0E+00 | 2.0E-07 |
| Chloride | 43.2578 | 0.00259547 | 2.4E-05 | | |
| Nitrogen, Ammonia | 69.5017 | 0.004170102 | 3.8E-05 | 1.0E+02 | 3.8E-07 |
| Sulfate as SO4 | 940.9124 | 0.056454746 | 5.2E-04 | | |
| | | | SUMMARY HAZARD INDEX | | 3E-03 |

ND = No data available.

CWSBIDAL
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SUBSURFACE SOIL - ENTIRE SITE (EXLUDING SULFATE LANDFILL)
RECEPTOR: CONSTRUCTION (EXCAVATION) WORKER - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A7-3

22-May-97

EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| CONCENTRATION SOIL | $[OHM]_{soil}$ | chemical specific | chemical-specific | |
| INGESTION RATE | IR | 500 | mg-soil/day | MADEP, 1995 |
| ADHERENCE FACTOR | AF | 0.51 | mg-soil/cm²-skin | MADEP, 1995 |
| AVERAGE SURFACE AREA (1) | SA | 5,200 | cm²/day | calculated per MADEP, 1995 |
| RELATIVE ABSORPTION FACTOR-ORAL | RAF-O | chemical specific | unitless | MADEP, 1994, 1995 |
| RELATIVE ABSORPTION FACTOR -DERM | RAF-D | chemical specific | unitless | MADEP, 1994, 1995 |
| CONVERSION FACTOR | CF | 1.00E-06 | kg/mg | |
| BODY WEIGHT | BW | 70 | kg | USEPA, 1989 |
| EXPOSURE PERIOD (2) | EP | 0.167 | years | Assumption |
| EXPOSURE FREQUENCY (2) | EF | 40 | events/year | Assumption |
| EXPOSURE DURATION | ED | 1 | day/event | Assumption |
| AVERAGING PERIOD | | | | |
| CANCER | AP | 75 | years | MADEP, 1995 |
| NONCANCER | AP | 0.167 | years | Assumption |

(1) 50th percentile surface areas for males: hands, arms, head.
(2) 5 days per week for 2 months.

MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
MADEP, 1995. Guidance for Disposal Site Risk Characterization. Interim Final Policy WSC/ORS-95-141. July 1995.
USEPA, 1989. Exposure Factors Handbook.EPA/600/8-89/043. May 1989.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)^-1

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE-INGESTION} = \frac{[OHM]soil \times IR \times RAF\text{-}O \times CF \times EF \times ED \times EP}{BW \times AP \times 365 \text{ days/yr}}$$

$$\text{INTAKE-DERMAL} = \frac{[OHM]soil \times SA \times AF \times RAF\text{-}D \times EF \times ED \times EP \times CF}{BW \times AP \times 365 \text{ days/yr}}$$

**CWSBIDAL**
**EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SUBSURFACE SOIL - ENTIRE SITE (EXLUDING SULFATE LANDFILL)**
**RECEPTOR: CONSTRUCTION (EXCAVATION) WORKER - FUTURE LAND USE**
**OLIN CORPORATION**
**WILMINGTON, MA FACILITY**
**TABLE A7-3**

22-May-97

**CARCINOGENIC EFFECTS**

| | SOIL CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | CANCER SLOPE FACTOR (mg/kg-day)^-1 | CANCER RISK INGESTION | CANCER RISK DERMAL | TOTAL CANCER RISK |
|---|---|---|---|---|---|---|---|---|---|
| 1,2-Dichloroethane | 0.0021 | 1.00 | 3.6E-12 | 0.10 | 1.9E-12 | 9.1E-02 | 3.3E-13 | 1.8E-13 | 5.1E-13 |
| Benzene | 0.0161 | 1.00 | 2.8E-11 | 0.08 | 1.2E-11 | 2.9E-02 | 8.2E-13 | 3.5E-13 | 1.2E-12 |
| Carbon Tetrachloride | 0.0002 | 1.00 | 3.5E-13 | 0.10 | 1.9E-13 | 1.3E-01 | 4.6E-14 | 2.4E-14 | 7.0E-14 |
| Chloroform | 0.0012 | 1.00 | 2.0E-12 | 0.10 | 1.1E-12 | 6.1E-03 | 1.2E-14 | 6.6E-15 | 1.9E-14 |
| Methylene Chloride | 0.0328 | 1.00 | 5.7E-11 | 0.10 | 3.0E-11 | 7.5E-03 | 4.3E-13 | 2.3E-13 | 6.6E-13 |
| Tetrachloroethene (PCE) | 0.0012 | 1.00 | 2.0E-12 | 0.10 | 1.1E-12 | 5.1E-02 | 1.0E-13 | 5.4E-14 | 1.6E-13 |
| Trichloroethene (TCE) | 0.0041 | 1.00 | 7.1E-12 | 0.10 | 3.8E-12 | 1.5E-02 | 1.1E-13 | 5.6E-14 | 1.6E-13 |
| 1,4-Dichlorobenzene | 0.0346 | 1.00 | 6.0E-11 | 0.10 | 3.2E-11 | 2.4E-02 | 1.4E-12 | 7.7E-13 | 2.2E-12 |
| 2-Methylphenol (o-Cresol) | 0.0338 | | | | | ND | | | |
| 4-Methylphenol(p-Cresol) | 0.0391 | | | | | ND | | | |
| Benzo(a)Anthracene | 0.0489 | 1.00 | 8.5E-11 | 0.20 | 9.0E-11 | 7.3E-01 | 6.2E-11 | 6.6E-11 | 1.3E-10 |
| Benzo(a)Pyrene | 0.0061 | 1.00 | 1.1E-11 | 0.20 | 1.1E-11 | 7.3E+00 | 7.7E-11 | 8.2E-11 | 1.6E-10 |
| Benzo(b)Fluoranthene | 0.0501 | 1.00 | 8.7E-11 | 0.20 | 9.3E-11 | 7.3E-01 | 6.4E-11 | 6.8E-11 | 1.3E-10 |
| Butylbenzylphthalate | 0.1535 | | | | | ND | | | |
| Chrysene | 0.1054 | 1.00 | 1.8E-10 | 0.20 | 1.9E-10 | 7.3E-03 | 1.3E-12 | 1.4E-12 | 2.8E-12 |
| Hexachlorobenzene | 0.0058 | 1.00 | 1.0E-11 | 0.13 | 6.9E-12 | 1.6E+00 | 1.6E-11 | 1.1E-11 | 2.7E-11 |
| Indeno (1,2,3-cd)Pyrene | 0.1334 | 1.00 | 2.3E-10 | 0.20 | 2.5E-10 | 7.3E-01 | 1.7E-10 | 1.8E-10 | 3.5E-10 |
| Isophorone | 0.0342 | 1.00 | 6.0E-11 | 0.19 | 5.9E-11 | 9.5E-04 | 5.7E-14 | 5.6E-14 | 1.1E-13 |
| N-Nitroso-di-n-propylamine | 0.3619 | 0.91 | 5.7E-10 | 0.17 | 5.7E-10 | 7.0E+00 | 4.0E-09 | 4.0E-09 | 8.0E-09 |
| N-Nitrosodiphenylamine | 109.0173 | 0.91 | 1.7E-07 | 0.17 | 1.7E-07 | 4.9E-03 | 8.5E-10 | 8.4E-10 | 1.7E-09 |
| bis(2-EthylHexyl)phthalate | 44.7304 | 1.00 | 7.8E-08 | 0.02 | 8.3E-09 | 1.4E-02 | 1.1E-09 | 1.2E-10 | 1.2E-09 |
| 4,4'-DDD | 0.0005 | 1.00 | 9.2E-13 | 0.20 | 9.7E-13 | 2.4E-01 | 2.2E-13 | 2.3E-13 | 4.5E-13 |
| Aldrin | 0.0003 | 1.00 | 5.3E-13 | 0.25 | 7.0E-13 | 1.7E+01 | 9.0E-12 | 1.2E-11 | 2.1E-11 |
| Alpha-BHC | 0.0003 | 0.96 | 4.6E-13 | 0.18 | 4.6E-13 | 6.3E+00 | 2.9E-12 | 2.9E-12 | 5.8E-12 |
| Alpha-Chlordane | 0.0230 | 1.00 | 4.0E-11 | 0.05 | 1.1E-11 | 1.3E+00 | 5.2E-11 | 1.4E-11 | 6.6E-11 |
| Gamma-BHC (Lindane) | 0.0014 | 1.00 | 2.5E-12 | 0.20 | 2.6E-12 | 1.3E+00 | 3.2E-12 | 3.4E-12 | 6.6E-12 |
| Toxaphene | 0.0460 | 0.96 | 7.7E-11 | 0.18 | 7.6E-11 | 1.1E+00 | 8.4E-11 | 8.4E-11 | 1.7E-10 |
| Arsenic | 6.0187 | 1.00 | 1.0E-08 | 0.03 | 1.7E-09 | 1.5E+00 | 1.6E-08 | 2.5E-09 | 1.8E-08 |
| Cadmium | 0.6359 | | | | | ND | | | |
| | | | | | SUMMARY CANCER RISK | | 2E-08 | 8E-09 | 3E-08 |

[1] MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
ND = no data available

CWSBIDAL
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NONCARCINOGENIC EFFECTS

| COMPOUND | SOIL CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | SUBCHRONIC RfD (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|
| 1,2-Dichloroethane | 0.0021 | 1.00 | 1.6E-09 | 0.10 | 8.7E-10 | 2.0E-02 | 8.2E-08 | 4.3E-08 | 1.3E-07 |
| 2,4,4-Trimethyl-1-pentene | 3.9307 | 0.99 | 3.0E-06 | 0.11 | 1.8E-06 | 2.1E-01 | 1.5E-05 | 8.8E-06 | 2.4E-05 |
| 2,4,4-Trimethyl-2-Pentene | 1.5589 | 0.99 | 1.2E-06 | 0.11 | 7.1E-07 | 2.1E-01 | 5.9E-06 | 3.5E-06 | 9.4E-06 |
| 2-Butanone (MEK) | 0.0142 | 1.00 | 1.1E-08 | 0.10 | 5.9E-09 | 2.0E+00 | 5.5E-09 | 2.9E-09 | 8.5E-09 |
| 2-Hexanone | 0.1762 | 1.00 | 1.4E-07 | 0.10 | 7.3E-08 | 2.0E+00 | 6.9E-08 | 3.7E-08 | 1.1E-07 |
| 4-Methyl-2-Pentanone (MIBK) | 0.0290 | 1.00 | 2.3E-08 | 0.10 | 1.2E-08 | 8.0E-01 | 2.8E-08 | 1.5E-08 | 4.3E-08 |
| Acetone | 2.3008 | 1.00 | 1.8E-06 | 0.10 | 9.6E-07 | 1.0E+00 | 1.8E-06 | 9.6E-07 | 2.8E-06 |
| Benzene | 0.0161 | 1.00 | 1.3E-08 | 0.08 | 5.4E-09 | 5.0E-02 | 2.5E-07 | 1.1E-07 | 3.6E-07 |
| Carbon Disulfide | 0.0149 | 1.09 | 1.3E-08 | 0.12 | 7.5E-09 | 1.0E-01 | 1.3E-07 | 7.5E-08 | 2.0E-07 |
| Carbon Tetrachloride | 0.0002 | 1.00 | 1.6E-10 | 0.10 | 8.3E-11 | 7.0E-04 | 2.2E-07 | 1.2E-07 | 3.4E-07 |
| Chlorobenzene | 0.0049 | 1.00 | 3.9E-09 | 0.10 | 2.0E-09 | 2.0E-01 | 1.9E-08 | 1.0E-08 | 3.0E-08 |
| Chloroform | 0.0012 | 1.00 | 9.1E-10 | 0.10 | 4.8E-10 | 1.0E-02 | 9.1E-08 | 4.8E-08 | 1.4E-07 |
| Ethylbenzene | 0.0944 | 1.00 | 7.4E-08 | 0.20 | 7.8E-08 | 1.0E+00 | 7.4E-08 | 7.8E-08 | 1.5E-07 |
| Methylene Chloride | 0.0328 | 1.00 | 2.6E-08 | 0.10 | 1.4E-08 | 6.0E-02 | 4.3E-07 | 2.3E-07 | 6.6E-07 |
| Styrene | 0.1243 | 1.00 | 9.7E-08 | 0.20 | 1.0E-07 | 2.0E+00 | 4.9E-08 | 5.2E-08 | 1.0E-07 |
| Tetrachloroethene (PCE) | 0.0012 | 1.00 | 9.0E-10 | 0.10 | 4.8E-10 | 1.0E-01 | 9.0E-09 | 4.8E-09 | 1.4E-08 |
| Toluene | 0.2352 | 1.00 | 1.8E-07 | 0.12 | 1.2E-07 | 2.0E+00 | 9.2E-08 | 5.9E-08 | 1.5E-07 |
| Trichloroethene (TCE) | 0.0041 | 1.00 | 3.2E-09 | 0.10 | 1.7E-09 | 2.0E-02 | 1.6E-07 | 8.4E-08 | 2.4E-07 |
| Xylenes, Total | 0.0170 | 1.00 | 1.3E-08 | 0.12 | 8.5E-09 | 4.0E+00 | 3.3E-09 | 2.1E-09 | 5.5E-09 |
| 1,2,3-Trichlorobenzene | 0.0125 | 1.00 | 9.8E-09 | 0.08 | 4.1E-09 | 1.0E-02 | 9.8E-07 | 4.1E-07 | 1.4E-06 |
| 1,2,4-Trichlorobenzene | 0.0235 | 1.00 | 1.8E-08 | 0.08 | 7.8E-09 | 1.0E-02 | 1.8E-06 | 7.8E-07 | 2.6E-06 |
| 1,2-Dichlorobenzene | 0.0296 | 1.00 | 2.3E-08 | 0.10 | 1.2E-08 | 9.0E-01 | 2.6E-08 | 1.4E-08 | 3.9E-08 |
| 1,3-Dichlorobenzene | 0.0070 | 0.96 | 5.2E-09 | 0.18 | 5.2E-09 | 9.0E-01 | 5.8E-09 | 5.8E-09 | 1.2E-08 |
| 1,4-Dichlorobenzene | 0.0346 | 0.96 | 2.6E-08 | 0.18 | 2.6E-08 | 9.0E-01 | 2.9E-08 | 2.9E-08 | 5.8E-08 |
| 2,4-Dimethylphenol | 0.0145 | 1.00 | 1.1E-08 | 0.26 | 1.6E-08 | 2.0E-01 | 5.7E-08 | 7.8E-08 | 1.4E-07 |
| 2-Methylnaphthalene | 0.0015 | 1.00 | 1.2E-09 | 0.20 | 1.3E-09 | 3.0E-02 | 3.9E-08 | 4.2E-08 | 8.1E-08 |
| 2-Methylphenol (o-Cresol) | 0.0338 | 1.00 | 2.6E-08 | 0.19 | 2.6E-08 | 5.0E-01 | 5.3E-08 | 5.2E-08 | 1.1E-07 |
| 4-Bromophenyl-phenylether | 0.0116 | | | | | | | | |
| 4-Chlorophenyl-phenylether | 0.0119 | | | | | | | | |
| 4-Methylphenol(p-Cresol) | 0.0391 | 1.00 | 3.1E-08 | 0.19 | 3.0E-08 | 5.0E-03 | 6.1E-06 | 6.1E-06 | 1.2E-05 |
| Anthracene | 0.0031 | 1.00 | 2.4E-09 | 0.29 | 3.7E-09 | 3.0E+00 | 8.0E-10 | 1.2E-09 | 2.0E-09 |
| Benzo(a)Anthracene | 0.0489 | 0.91 | 3.5E-08 | 0.18 | 3.7E-08 | 3.0E-02 | 1.2E-06 | 1.2E-06 | 2.4E-06 |
| Benzo(a)Pyrene | 0.0061 | 0.91 | 4.3E-09 | 0.18 | 4.5E-09 | 3.0E-02 | 1.4E-07 | 1.5E-07 | 2.9E-07 |
| Benzo(b)Fluoranthene | 0.0501 | 0.91 | 3.6E-08 | 0.18 | 3.7E-08 | 3.0E-02 | 1.2E-06 | 1.2E-06 | 2.4E-06 |
| Butylbenzylphthalate | 0.1535 | 0.96 | 1.2E-07 | 0.18 | 1.1E-07 | 2.0E+00 | 5.8E-08 | 5.7E-08 | 1.1E-07 |
| Chrysene | 0.1054 | 0.91 | 7.5E-08 | 0.18 | 7.9E-08 | 3.0E-02 | 2.5E-06 | 2.6E-06 | 5.1E-06 |
| Di-n-butylphthalate | 0.1539 | 0.96 | 1.2E-07 | 0.18 | 1.1E-07 | 1.0E+00 | 1.2E-07 | 1.1E-07 | 2.3E-07 |
| Di-n-octylphthalate | 0.2835 | 0.96 | 2.1E-07 | 0.18 | 2.1E-07 | 2.0E-02 | 1.1E-05 | 1.1E-05 | 2.1E-05 |
| Dibenzofuran | 0.0130 | 1.00 | 1.0E-08 | 0.19 | 1.0E-08 | 3.0E-02 | 3.4E-07 | 3.3E-07 | 6.7E-07 |
| Diethylphthalate | 0.0462 | 1.00 | 3.6E-08 | 0.02 | 3.8E-09 | 8.0E+00 | 4.5E-09 | 4.8E-10 | 5.0E-09 |
| Fluoranthene | 0.0196 | 1.00 | 1.5E-08 | 0.20 | 1.6E-08 | 4.0E-01 | 3.8E-08 | 4.1E-08 | 7.9E-08 |

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TABLE A7-3

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NONCARCINOGENIC EFFECTS

| COMPOUND | SOIL CONCENTRATION (mg/kg) | INGESTION RAF (1) | INTAKE INGESTION (mg/kg-day) | DERMAL RAF (1) | INTAKE DERMAL (mg/kg-day) | SUBCHRONIC RfD (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|
| Hexachlorobenzene | 0.0058 | 1.00 | 4.5E-09 | 0.13 | 3.1E-09 | 8.0E-04 | 5.6E-06 | 3.9E-06 | 9.5E-06 |
| Indeno (1,2,3-cd)Pyrene | 0.1334 | 0.91 | 9.5E-08 | 0.18 | 1.0E-07 | 3.0E-02 | 3.2E-06 | 3.3E-06 | 6.5E-06 |
| Isophorone | 0.0342 | 1.00 | 2.7E-08 | 0.19 | 2.7E-08 | 2.0E+00 | 1.3E-08 | 1.3E-08 | 2.7E-08 |
| N-Nitroso-di-n-propylamine | 0.3619 | 0.91 | 2.6E-07 | 0.17 | 2.6E-07 | 9.5E-02 | 2.7E-06 | 2.7E-06 | 5.4E-06 |
| N-Nitrosodiphenylamine | 109.0173 | 0.96 | 8.2E-05 | 0.18 | 8.1E-05 | 5.0E-02 | 1.6E-03 | 1.6E-03 | 3.3E-03 |
| Naphthalene | 0.0834 | 1.00 | 6.5E-08 | 0.10 | 3.5E-08 | 4.0E-02 | 1.6E-06 | 8.7E-07 | 2.5E-06 |
| Phenanthrene | 0.0212 | 0.91 | 1.5E-08 | 0.18 | 1.6E-08 | 3.0E-02 | 5.0E-07 | 5.3E-07 | 1.0E-06 |
| Phenol | 2.0707 | 1.00 | 1.6E-06 | 0.26 | 2.2E-06 | 6.0E-01 | 2.7E-06 | 3.7E-06 | 6.4E-06 |
| Pyrene | 0.1610 | 1.00 | 1.3E-07 | 0.20 | 1.3E-07 | 3.0E-01 | 4.2E-07 | 4.5E-07 | 8.7E-07 |
| bis(2-EthylHexyl)phthalate | 44.7304 | 1.00 | 3.5E-05 | 0.02 | 3.7E-06 | 2.0E-02 | 1.8E-03 | 1.9E-04 | 1.9E-03 |
| 4,4'-DDD | 0.0005 | 0.96 | 3.9E-10 | 0.18 | 3.9E-10 | 5.0E-04 | 7.9E-07 | 7.8E-07 | 1.6E-06 |
| Aldrin | 0.0003 | 1.00 | 2.4E-10 | 0.25 | 3.1E-10 | 3.0E-05 | 7.9E-06 | 1.0E-05 | 1.8E-05 |
| Alpha-BHC | 0.0003 | 0.96 | 2.1E-10 | 0.18 | 2.1E-10 | 5.0E-04 | 4.1E-07 | 4.1E-07 | 8.2E-07 |
| Alpha-Chlordane | 0.0230 | 1.00 | 1.8E-08 | 0.05 | 4.8E-09 | 6.0E-05 | 3.0E-04 | 8.0E-05 | 3.8E-04 |
| Endosulfan I | 0.0002 | 0.96 | 1.4E-10 | 0.18 | 1.4E-10 | 6.0E-03 | 2.4E-08 | 2.3E-08 | 4.7E-08 |
| Endosulfan Sulfate | 0.0009 | 0.96 | 6.8E-10 | 0.18 | 6.7E-10 | 6.0E-03 | 1.1E-07 | 1.1E-07 | 2.2E-07 |
| Endrin | 0.0007 | 1.00 | 5.4E-10 | 0.25 | 7.2E-10 | 3.0E-04 | 1.8E-06 | 2.4E-06 | 4.2E-06 |
| Endrin Ketone | 0.0022 | 0.96 | 1.7E-09 | 0.18 | 1.7E-09 | 3.0E-04 | 5.6E-06 | 5.6E-06 | 1.1E-05 |
| Gamma-BHC (Lindane) | 0.0014 | 1.00 | 1.1E-09 | 0.20 | 1.2E-09 | 3.0E-03 | 3.7E-07 | 3.9E-07 | 7.6E-07 |
| Methoxychlor | 0.0230 | 1.00 | 1.8E-08 | 0.20 | 1.9E-08 | 5.0E-03 | 3.6E-06 | 3.8E-06 | 7.4E-06 |
| Toxaphene | 0.0458 | 0.96 | 3.4E-08 | 0.18 | 3.4E-08 | 5.0E-05 | 6.9E-04 | 6.8E-04 | 1.4E-03 |
| Antimony | 0.2226 | 1.00 | 1.7E-07 | 0.10 | 9.2E-08 | 4.0E-04 | 4.4E-04 | 2.3E-04 | 6.7E-04 |
| Arsenic | 6.0187 | 1.00 | 4.7E-06 | 0.03 | 7.5E-07 | 3.0E-04 | 1.6E-02 | 2.5E-03 | 1.8E-02 |
| Barium | 17.4645 | 0.71 | 9.7E-06 | 0.05 | 4.0E-06 | 7.0E-02 | 1.4E-04 | 5.7E-05 | 1.9E-04 |
| Cadmium | 0.6359 | 1.00 | 5.0E-07 | 0.14 | 3.7E-07 | 5.0E-04 | 1.0E-03 | 7.4E-04 | 1.7E-03 |
| Calcium | 1466.2349 | | | | | | | | |
| Chromium III | 76.8600 | 1.00 | 6.0E-05 | 0.04 | 1.3E-05 | 1.0E+00 | 6.0E-05 | 1.3E-05 | 7.3E-05 |
| Cobalt | 2.2048 | 1.86 | 3.2E-06 | 0.14 | 1.3E-06 | 6.0E-02 | 5.4E-05 | 2.2E-05 | 7.5E-05 |
| Copper | 6.1031 | | | | | | | | |
| Cyanide | 0.0480 | 1.00 | 3.8E-08 | 0.30 | 6.0E-08 | 2.0E-02 | 1.9E-06 | 3.0E-06 | 4.9E-06 |
| Iron | 6740.3518 | | | | | | | | |
| Manganese | 79.5508 | 1.86 | 1.2E-04 | 0.14 | 4.7E-05 | 4.7E-02 | 2.5E-03 | 1.0E-03 | 3.5E-03 |
| Mercury | 0.0032 | 1.00 | 2.5E-09 | 0.05 | 6.6E-10 | 3.0E-04 | 8.2E-06 | 2.2E-06 | 1.0E-05 |
| Nickel | 5.8979 | 1.00 | 4.6E-06 | 0.35 | 8.6E-06 | 2.0E-02 | 2.3E-04 | 4.3E-04 | 6.6E-04 |
| Potassium | 772.9860 | | | | | | | | |
| Silver | 0.7425 | 1.00 | 5.8E-07 | 0.25 | 7.7E-07 | 5.0E-03 | 1.2E-04 | 1.5E-04 | 2.7E-04 |
| Sodium | 117.7923 | | | | | | | | |
| Vanadium | 2.2380 | 0.71 | 1.2E-06 | 0.05 | 5.1E-07 | 7.0E-03 | 1.8E-04 | 7.2E-05 | 2.5E-04 |
| Chloride | 43.2578 | | | | | | | | |
| Nitrogen, Ammonia | 69.5017 | 0.71 | 3.9E-05 | 0.05 | 1.6E-05 | 3.7E-01 | 1.0E-04 | 4.3E-05 | 1.5E-04 |
| Sulfate as SO4 | 940.9124 | | | | | | | | |
| Chromium VI | 8.5400 | 1.00 | 6.7E-06 | 0.09 | 3.2E-06 | 2.0E-02 | 3.3E-04 | 1.6E-04 | 4.9E-04 |
| SUMMARY HAZARD INDEX | | | | | | | [illegible] | [illegible] | [illegible] |

CWSBINAL
INHALATION EXPOSURE TO OHM IN SUBSURFACE SOIL PARTICULATES - ENTIRE SITE (EXCLUDING SULFATE LANDFILL)
RECEPTOR: CONSTRUCTION (EXCAVATION) WORKER - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A7-4

22-May-97

EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| CONCENTRATION IN AIR | [RP]air | 60 | ug/m3 | MADEP, 1995 |
| CONCENTRATION IN SOIL | [OHM]part | chemical-specific | mg/kg | |
| CONVERSION FACTOR 1 | CF1 | 24 | hours/day | |
| EXPOSURE TIME DAILY | ET | 8 | hours/day | Assumption |
| EXPOSURE FREQUENCY (1) | EF | 40 | days/year | Assumption |
| EXPOSURE DURATION (1) | ED | 0.167 | years | Assumption |
| CONVERSION FACTOR 2 | CF2 | 365 | days/year | |
| CONVERSION FACTOR 3 | CF3 | 0.000001 | kg/mg | |
| AVERAGING TIME CANCER | AT | 75 | years | MADEP, 1995 |
| AVERAGING TIME NONCANCER | AT | 0.167 | years | Assumption |

(1) 5 days per week for 2 months.
MADEP, 1995. Guidance for Disposal Site Risk Characterization, Interim Final Policy WSC/ORS-95-141. July.

EQUATIONS

CANCER RISK = AVG. CONC. (ug/m3) * CANCER UNIT RISK (ug/m3)^-1

HAZARD QUOTIENT = AVG.CONC.(ug/m3)/REF. CONC. (ug/m3)

$$\text{AVG. EXPOSURE CONC.} = \frac{[OHM]air * EF * ET * ED}{AT * CF1 * CF2}$$

OHM AIR CONC. = [RP]air * [OHM]part * CF3

Note:
*For noncarcinogenic effects: AT = ED

CWSBINAL
INHALATION EXPOSURE TO OHM IN SUBSURFACE SOIL PARTICULATES - ENTIRE SITE (EXCLUDING SULFATE LANDFILL)
RECEPTOR: CONSTRUCTION (EXCAVATION) WORKER - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A7-4

22-May-97
CARCINOGENIC EFFECTS

| COMPOUND | OHM SOIL CONCENTRATION (mg/kg) | OHM AIR CONCENTRATION (ug/m³) | AVERAGE AIR CONCENTRATION LIFETIME (ug/m3) | INHALATION CANCER UNIT RISK (ug/m3)^-1 | CANCER RISK |
|---|---|---|---|---|---|
| 1,2-Dichloroethane | 0.0021 | 1.2564E-07 | 1.0E-11 | 2.6E-05 | 2.7E-16 |
| Benzene | 0.0161 | 9.6864E-07 | 7.9E-11 | 8.3E-06 | 6.5E-16 |
| Carbon Tetrachloride | 0.0002 | 1.206E-08 | 9.8E-13 | 1.5E-05 | 1.5E-17 |
| Chloroform | 0.0012 | 7.008E-08 | 5.7E-12 | 2.3E-05 | 1.3E-16 |
| Methylene Chloride | 0.0328 | 1.96896E-06 | 1.6E-10 | 4.7E-07 | 7.5E-17 |
| Tetrachloroethene (PCE) | 0.0012 | 6.9276E-08 | 5.6E-12 | 5.9E-06 | 3.3E-17 |
| Trichloroethene (TCE) | 0.0041 | 2.4396E-07 | 2.0E-11 | 2.0E-06 | 4.0E-17 |
| 1,4-Dichlorobenzene | 0.0346 | 2.07464E-06 | 1.7E-10 | 1.1E-05 | 1.9E-15 |
| 2-Methylphenol (o-Cresol) | 0.0338 | 2.0292E-06 | 1.7E-10 | | |
| 4-Methylphenol(p-Cresol) | 0.0391 | 2.34408E-06 | 1.9E-10 | | |
| Benzo(a)Anthracene | 0.0489 | 2.93568E-06 | 2.4E-10 | 1.1E-04 | 2.6E-14 |
| Benzo(a)Pyrene | 0.0061 | 0.000000363 | 3.0E-11 | 1.1E-03 | 3.2E-14 |
| Benzo(b)Fluoranthene | 0.0501 | 3.00636E-06 | 2.4E-10 | 1.1E-04 | 2.7E-14 |
| Butylbenzylphthalate | 0.1535 | 9.21199E-06 | 7.5E-10 | | |
| Chrysene | 0.1054 | 6.32298E-06 | 5.1E-10 | 1.1E-06 | 5.7E-16 |
| Hexachlorobenzene | 0.0058 | 3.456E-07 | 2.8E-11 | 4.6E-04 | 1.3E-14 |
| Indeno (1,2,3-cd)Pyrene | 0.1334 | 8.0064E-06 | 6.5E-10 | 1.1E-04 | 7.2E-14 |
| Isophorone | 0.0342 | 2.0538E-06 | 1.7E-10 | | |
| N-Nitroso-di-n-propylamine | 0.3619 | 2.17145E-05 | 1.8E-09 | 2.0E-03 | 3.5E-12 |
| N-Nitrosodiphenylamine | 109.0173 | 0.006541041 | 5.3E-07 | 2.6E-06 | 1.4E-12 |
| bis(2-EthylHexyl)phthalate | 44.7304 | 0.002683823 | 2.2E-07 | 2.4E-06 | 5.2E-13 |
| 4,4'-DDD | 0.0005 | 3.1536E-08 | 2.6E-12 | 9.7E-05 | 2.5E-16 |
| Aldrin | 0.0003 | 1.8144E-08 | 1.5E-12 | 4.9E-03 | 7.2E-15 |
| Alpha-BHC | 0.0003 | 1.656E-08 | 1.3E-12 | 1.8E-03 | 2.4E-15 |
| Alpha-Chlordane | 0.0230 | 1.3797E-06 | 1.1E-10 | 3.7E-04 | 4.2E-14 |
| Gamma-BHC (Lindane) | 0.0014 | 8.514E-08 | 6.9E-12 | 1.8E-05 | 1.3E-16 |
| Toxaphene | 0.0460 | 2.75852E-06 | 2.2E-10 | 3.2E-04 | 7.2E-14 |
| Arsenic | 6.0187 | 0.000361123 | 2.9E-08 | 4.3E-03 | 1.3E-10 |
| Cadmium | 0.6359 | 3.81529E-05 | 3.1E-09 | 1.8E-03 | 5.6E-12 |
| Chromium VI | 8.54 | 0.0005124 | 4.2E-08 | 1.2E-02 | 5.0E-10 |
| Nickel | 5.8979 | 0.000353875 | 2.9E-08 | 2.4E-04 | 6.9E-12 |
| | | | SUMMARY CANCER RISK | | 6E-10 |

ND = No data available.

CWSBINAL
INHALATION EXPOSURE TO OHM IN SUBSURFACE SOIL PARTICULATES - ENTIRE SITE (EXCLUDING SULFATE LANDFILL)
RECEPTOR: CONSTRUCTION (EXCAVATION) WORKER - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A7-4

22-May-97

| COMPOUND | OHM SOIL CONCENTRATION mg/kg | OHM AIR CONCENTRATION (ug/m3) | AVERAGE AIR CONCENTRATION FOR TIME PERIOD (ug/m3) | SUBCHRONIC INHALATION RfC [1] (ug/m3) | HAZARD QUOTIENT |
|---|---|---|---|---|---|
| 1,2-Dichloroethane | 0.0021 | 1.2564E-07 | 4.6E-09 | 5.5E+01 | 8.3E-11 |
| 2,4,4-Trimethyl-1-pentene | 3.9307 | 0.000235843 | 8.6E-06 | 7.2E+02 | 1.2E-08 |
| 2,4,4-Trimethyl-2-Pentene | 1.5589 | 9.35356E-05 | 3.4E-06 | 7.2E+02 | 4.8E-09 |
| 2-Butanone (MEK) | 0.0142 | 8.4973E-07 | 3.1E-08 | 1.0E+03 | 3.1E-11 |
| 2-Hexanone | 0.1762 | 1.05717E-05 | 3.9E-07 | 5.0E+01 | 7.7E-09 |
| 4-Methyl-2-Pentanone (MIBK) | 0.0290 | 1.7385E-06 | 6.4E-08 | 8.0E+02 | 7.9E-11 |
| Acetone | 2.3008 | 0.000138048 | 5.0E-06 | 8.0E+02 | 6.3E-09 |
| Benzene | 0.0161 | 9.6864E-07 | 3.5E-08 | 3.2E+01 | 1.1E-09 |
| Carbon Disulfide | 0.0149 | 8.94168E-07 | 3.3E-08 | 1.0E+01 | 3.3E-09 |
| Carbon Tetrachloride | 0.0002 | 1.206E-08 | 4.4E-10 | 4.3E+02 | 1.0E-12 |
| Chlorobenzene | 0.0049 | 2.96034E-07 | 1.1E-08 | 2.0E+01 | 5.4E-10 |
| Chloroform | 0.0012 | 7.008E-08 | 2.6E-09 | 6.6E+02 | 3.9E-12 |
| Ethylbenzene | 0.0944 | 5.66111E-06 | 2.1E-07 | 1.0E+03 | 2.1E-10 |
| Methylene Chloride | 0.0328 | 1.96896E-06 | 7.2E-08 | 3.0E+03 | 2.4E-11 |
| Styrene | 0.1243 | 7.45938E-06 | 2.7E-07 | 3.0E+03 | 9.1E-11 |
| Tetrachloroethene (PCE) | 0.0012 | 6.9276E-08 | 2.5E-09 | 4.6E+03 | 5.5E-13 |
| Toluene | 0.2352 | 1.41097E-05 | 5.2E-07 | 4.0E+02 | 1.3E-09 |
| Trichloroethene (TCE) | 0.0041 | 2.4396E-07 | 8.9E-09 | 1.8E+02 | 5.0E-11 |
| Xylenes, Total | 0.0170 | 1.02175E-06 | 3.7E-08 | 3.0E+02 | 1.2E-10 |
| 1,2,3-Trichlorobenzene | 0.0125 | 7.476E-07 | 2.7E-08 | 2.0E+03 | 1.4E-11 |
| 1,2,4-Trichlorobenzene | 0.0235 | 1.40812E-06 | 5.1E-08 | 2.0E+03 | 2.6E-11 |
| 1,2-Dichlorobenzene | 0.0296 | 1.77692E-06 | 6.5E-08 | 2.0E+03 | 3.2E-11 |
| 1,3-Dichlorobenzene | 0.0070 | 4.176E-07 | 1.5E-08 | 2.0E+03 | 7.6E-12 |
| 1,4-Dichlorobenzene | 0.0346 | 2.07464E-06 | 7.6E-08 | 2.5E+03 | 3.0E-11 |
| 2,4-Dimethylphenol | 0.0145 | 8.7042E-07 | 3.2E-08 | | |
| 2-Methylnaphthalene | 0.0015 | 9.072E-08 | 3.3E-09 | 7.1E+01 | 4.7E-11 |
| 2-Methylphenol (o-Cresol) | 0.0338 | 2.0292E-06 | 7.4E-08 | 1.0E+02 | 7.4E-10 |
| 4-Bromophenyl-phenylether | 0.0116 | 6.948E-07 | 2.5E-08 | | |
| 4-Chlorophenyl-phenylether | 0.0119 | 7.16688E-07 | 2.6E-08 | | |
| 4-Methylphenol(p-Cresol) | 0.0391 | 2.34408E-06 | 8.6E-08 | 1.0E+02 | 8.6E-10 |
| Anthracene | 0.0031 | 1.848E-07 | 6.8E-09 | 7.1E+01 | 9.5E-11 |
| Benzo(a)Anthracene | 0.0489 | 2.93568E-06 | 1.1E-07 | 7.1E+01 | 1.5E-09 |
| Benzo(a)Pyrene | 0.0061 | 0.000000363 | 1.3E-08 | 7.1E+01 | 1.9E-10 |
| Benzo(b)Fluoranthene | 0.0501 | 3.00636E-06 | 1.1E-07 | 7.1E+01 | 1.5E-09 |
| Butylbenzylphthalate | 0.1535 | 9.21199E-06 | 3.4E-07 | 7.0E+00 | 4.8E-08 |
| Chrysene | 0.1054 | 6.32298E-06 | 2.3E-07 | 7.1E+01 | 3.3E-09 |
| Di-n-butylphthalate | 0.1539 | 9.2319E-06 | 3.4E-07 | 7.0E+00 | 4.8E-08 |
| Di-n-octylphthalate | 0.2835 | 1.701E-05 | 6.2E-07 | 7.0E+00 | 8.9E-08 |
| Dibenzofuran | 0.0130 | 7.7706E-07 | 2.8E-08 | | |
| Diethylphthalate | 0.0462 | 2.7702E-06 | 1.0E-07 | 7.0E+00 | 1.4E-08 |
| Fluoranthene | 0.0196 | 1.17408E-06 | 4.3E-08 | 7.1E+01 | 6.0E-10 |

**CWSBINAL**
**INHALATION EXPOSURE TO OHM IN SUBSURFACE SOIL PARTICULATES - ENTIRE SITE (EXCLUDING SULFATE LANDFILL)**
**RECEPTOR: CONSTRUCTION (EXCAVATION) WORKER - FUTURE LAND USE**
**OLIN CORPORATION**
**WILMINGTON, MA FACILITY**
**TABLE A7-4**

22-May-97

| COMPOUND | OHM SOIL CONCENTRATION mg/kg | OHM AIR CONCENTRATION (ug/m3) | AVERAGE AIR CONCENTRATION FOR TIME PERIOD (ug/m3) | SUBCHRONIC INHALATION RfC [1] (ug/m3) | HAZARD QUOTIENT |
|---|---|---|---|---|---|
| Hexachlorobenzene | 0.0058 | 3.456E-07 | 1.3E-08 | | |
| Indeno (1,2,3-cd)Pyrene | 0.1334 | 8.0064E-06 | 2.9E-07 | 7.1E+01 | 4.1E-09 |
| Isophorone | 0.0342 | 2.0538E-06 | 7.5E-08 | | |
| N-Nitroso-di-n-propylamine | 0.3619 | 2.17145E-05 | 7.9E-07 | | |
| N-Nitrosodiphenylamine | 109.0173 | 0.006541041 | 2.4E-04 | | |
| Naphthalene | 0.0834 | 5.00514E-06 | 1.8E-07 | 7.1E+01 | 2.6E-09 |
| Phenanthrene | 0.0212 | 1.27498E-06 | 4.7E-08 | 7.1E+01 | 6.6E-10 |
| Phenol | 2.0707 | 0.000124242 | 4.5E-06 | 2.6E+02 | 1.7E-08 |
| Pyrene | 0.1610 | 0.00000966 | 3.5E-07 | 7.1E+01 | 5.0E-09 |
| bis(2-EthylHexyl)phthalate | 44.7304 | 0.002683823 | 9.8E-05 | 7.0E+00 | 1.4E-05 |
| 4,4'-DDD | 0.0005 | 3.1536E-08 | 1.2E-09 | | |
| Aldrin | 0.0003 | 1.8144E-08 | 6.6E-10 | | |
| Alpha-BHC | 0.0003 | 1.656E-08 | 6.0E-10 | 7.0E-01 | 8.6E-10 |
| Alpha-Chlordane | 0.0230 | 1.3797E-06 | 5.0E-08 | 7.0E-01 | 7.2E-08 |
| Endosulfan I | 0.0002 | 1.13742E-08 | 4.2E-10 | | |
| Endosulfan Sulfate | 0.0009 | 5.4144E-08 | 2.0E-09 | | |
| Endrin | 0.0007 | 4.1616E-08 | 1.5E-09 | | |
| Endrin Ketone | 0.0022 | 1.3464E-07 | 4.9E-09 | | |
| Gamma-BHC (Lindane) | 0.0014 | 8.514E-08 | 3.1E-09 | 7.0E-01 | 4.4E-09 |
| Methoxychlor | 0.0230 | 1.3797E-06 | 5.0E-08 | | |
| Toxaphene | 0.0458 | 2.7468E-06 | 1.0E-07 | | |
| Antimony | 0.2226 | 1.33567E-05 | 4.9E-07 | 1.0E+01 | 4.9E-08 |
| Arsenic | 6.0187 | 0.000361123 | 1.3E-05 | 2.5E-03 | 5.3E-03 |
| Barium | 17.4645 | 0.00104787 | 3.8E-05 | 5.0E+00 | 7.7E-06 |
| Cadmium | 0.6359 | 3.81529E-05 | 1.4E-06 | 2.0E-01 | 7.0E-06 |
| Calcium | 1466.2349 | 0.087974094 | 3.2E-03 | | |
| Chromium III | 76.8600 | 0.0046116 | 1.7E-04 | 6.8E+00 | 2.5E-05 |
| Chromium VI | 8.5400 | 0.0005124 | 1.9E-05 | 2.0E-02 | 9.4E-04 |
| Cobalt | 2.2048 | 0.000132287 | 4.8E-06 | | |
| Copper | 6.1031 | 0.000366183 | 1.3E-05 | 2.7E+00 | 5.0E-06 |
| Cyanide | 0.0480 | 0.00000288 | 1.1E-07 | 7.0E+00 | 1.5E-08 |
| Iron | 6740.3518 | 0.404421108 | 1.5E-02 | | |
| Manganese | 79.5508 | 0.00477305 | 1.7E-04 | 5.0E-02 | 3.5E-03 |
| Mercury | 0.0032 | 1.89481E-07 | 6.9E-09 | 3.0E-01 | 2.3E-08 |
| Nickel | 5.8979 | 0.000353875 | 1.3E-05 | 9.0E-03 | 1.4E-03 |
| Potassium | 772.9860 | 0.046379158 | 1.7E-03 | | |
| Silver | 0.7425 | 4.45516E-05 | 1.6E-06 | | |
| Sodium | 117.7923 | 0.007067537 | 2.6E-04 | | |
| Vanadium | 2.2380 | 0.000134279 | 4.9E-06 | 6.0E+00 | 8.2E-07 |
| Chloride | 43.2578 | 0.00259547 | 9.5E-05 | | |
| Nitrogen, Ammonia | 69.5017 | 0.004170102 | 1.5E-04 | 1.0E+02 | 1.5E-06 |
| Sulfate as SO4 | 940.9124 | 0.056454746 | 2.1E-03 | | |
| | | | SUMMARY HAZARD INDEX | | 1E-02 |

ND = No data available.

ATTACHMENT 8

# ATTACHMENT 8

# GROUNDWATER RISK CALCULATION SPREADSHEETS

ALTRON
DIRECT CONTACT WITH PROCESS WATER (GROUNDWATER) - ALTRON WELLS
RECEPTOR: OFF-SITE WORKER - CURRENT AND FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A8-1
EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| Concentration in Groundwater | OHMgw | chemical-specific | mg/liter | |
| Lifetime Average Daily Dose | LADD | calculated below | | MADEP, 1995 |
| Average Daily Dose | ADD | calculated below | | MADEP, 1995 |
| Ingestion Rate (1) | IR | 0 | liters/hour | Assumption |
| Surface Area Exposed (2) | SA | 1,980 | $cm^2$ | MADEP, 1995 |
| Body Weight (2) | BW | 70 | kg | MADEP, 1995 |
| Conversion Factor | CF | 0.001 | liter/$cm^3$ | |
| Exposure Time | ET | 2 | hours/event | Assumption |
| Exposure Frequency | EF | 250 | event/year | Assumption |
| Exposure Period | EP | 25 | years | Assumption |
| Averaging Time | | | | |
| Cancer | ATc | 75 | years | MADEP, 1995 |
| Noncancer | ATn | 25 | years | Assumption |
| Relative Absorption Factor (RAF) | | | | |
| Oral | RAFo | listed below | unitless | MADEP, 1995 |
| Dermal | RAFd | listed below | unitless | MADEP, 1995 |
| Permeability Constant | Kp | listed below | cm/hour | MADEP, 1995 |

(1) No groundwater ingestion exposures.
(2) 50th percentile of surface areas for males: hands, forearms.
MADEP, 1995. "Guidance for Disposal Site Risk Characterization."

EQUATIONS

CANCER RISK = LADD (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = ADD (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{LADD-INGESTION} = \frac{OHMgw \times IR \times RAFi \times EF \times EP \times ET}{BW \times ATc \times 365 \text{ days/yr}}$$

$$\text{ADD-INGESTION} = \frac{OHMgw \times IR \times RAFi \times EF \times EP \times ET}{BW \times ATn \times 365 \text{ days/yr}}$$

$$\text{LADD-DERMAL} = \frac{OHMgw \times SA \times Kp \times RAFd \times CF \times ET \times EF \times EP}{BW \times ATc \times 365 \text{ days/yr}}$$

$$\text{ADD-DERMAL} = \frac{OHMgw \times SA \times Kp \times RAFd \times CF \times ET \times EF \times EP}{BW \times ATn \times 365 \text{ days/yr}}$$

Note:

For noncarcinogenic risk, AT = EP

ALTRON
DIRECT CONTACT WITH PROCESS WATER (GROUNDWATER) - ALTRON WELLS
RECEPTOR: OFF-SITE WORKER - CURRENT AND FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A8-1
CARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | DERMAL RAF | INTAKE DERMAL (mg/kg-day) | CANCER SLOPE FACTOR (mg/kg-day)^-1 | CANCER RISK INGESTION | CANCER RISK DERMAL | TOTAL CANCER RISK |
|---|---|---|---|---|---|---|---|---|---|---|
| bis(2-EthylHexyl)phthalate | 0.0050 | 1.00 | 0.0E+00 | 5.3E-03 | 1.05 | 3.6E-07 | 1.4E-02 | 0.0E+00 | 5.1E-09 | 5.1E-09 |
| | | | | | | | SUMMARY CANCER RISK | 0E+00 | 5E-09 | 5E-09 |

ALTRON
DIRECT CONTACT WITH PROCESS WATER (GROUNDWATER) - ALTRON WELLS
RECEPTOR: OFF-SITE WORKER - CURRENT AND FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A8-1
NONCARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | DERMAL RAF | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|---|
| 2,4,4-Trimethyl-1-pentene | 0.0040 | 0.99 | 0.0E+00 | 2.3E-01 | 1.00 | 3.6E-05 | 2.1E-01 | 0.0E+00 | 1.8E-04 | 1.8E-04 |
| 2,4,4-Trimethyl-2-Pentene | 0.0010 | 0.99 | 0.0E+00 | 2.3E-01 | 1.00 | 9.0E-06 | 2.1E-01 | 0.0E+00 | 4.4E-05 | 4.4E-05 |
| Acetone | 0.0070 | 1.00 | 0.0E+00 | 5.7E-04 | 1.00 | 1.5E-07 | 1.0E-01 | 0.0E+00 | 1.5E-06 | 1.5E-06 |
| Diethylphthalate | 0.0010 | 1.00 | 0.0E+00 | 5.3E-03 | 1.05 | 2.2E-07 | 8.0E-01 | 0.0E+00 | 2.7E-07 | 2.7E-07 |
| bis(2-EthylHexyl)phthalate | 0.0050 | 1.00 | 0.0E+00 | 5.3E-03 | 1.05 | 1.1E-06 | 2.0E-02 | 0.0E+00 | 5.4E-05 | 5.4E-05 |
| Aluminum | 0.2200 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Barium | 0.0510 | 0.73 | 0.0E+00 | 1.0E-03 | 1.82 | 3.6E-06 | 7.0E-02 | 0.0E+00 | 5.1E-05 | 5.1E-05 |
| Calcium | 20.0000 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Copper | 0.0700 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Iron | 0.8400 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Lead | 0.0100 | 0.50 | 0.0E+00 | 1.0E-03 | 2.00 | 7.7E-07 | 7.5E-04 | 0.0E+00 | 1.0E-03 | 1.0E-03 |
| Magnesium | 4.4000 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Manganese | 3.6400 | 1.90 | 0.0E+00 | 1.0E-03 | 4.76 | 6.7E-04 | 4.7E-02 | 0.0E+00 | 1.4E-02 | 1.4E-02 |
| Potassium | 5.0000 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Sodium | 85.4000 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Zinc | 0.0370 | 1.00 | 0.0E+00 | 1.0E-03 | 4.76 | 6.8E-06 | 3.0E-01 | 0.0E+00 | 2.3E-05 | 2.3E-05 |
| Chloride | 180.0000 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Nitrogen, Ammonia | 60.7000 | 0.73 | 0.0E+00 | 1.0E-03 | 1.82 | 4.3E-03 | 9.7E-01 | 0.0E+00 | 4.4E-03 | 4.4E-03 |
| Sulfate as SO4 | 316.0000 | | | 1.0E-03 | | 0.0E+00 | | | | |
| | | | | | | | SUMMARY HAZARD INDEX | 0E+00 | 2E-02 | 2E-02 |

OFWALTIN
TABLE A8-2
INHALATION EXPOSURE TO VOLATILE OHM IN BUILDING AIR FROM PROCESS WATER (GROUNDWATER)
RECEPTOR: OFF-SITE WORKER

OLIN CORPORATION
WILMINGTON, MA FACILITY
19-Jun-97

EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| CONCENTRATION IN AIR | [OHM]air | Modeled | ug/m3 | |
| CONVERSION FACTOR 1 | CF1 | 24 | hours/day | |
| EXPOSURE TIME DAILY (1) | ET | 8 | hours/day | Assumption |
| EXPOSURE FREQUENCY (2) | EF | 250 | days/year | Assumption |
| EXPOSURE DURATION | ED | 25 | years | USEPA, 1991 |
| CONVERSION FACTOR 2 | CF2 | 365 | days/year | |
| CONVERSION FACTOR 3 | CF3 | 0.000001 | kg/mg | |
| AVERAGING TIME CANCER | AT | 75 | years | MADEP, 1995 |
| AVERAGING TIME NONCANCER | AT | 25 | years | USEPA, 1991 |

(1) 12 hours per event, with each event occurring over a 6 day period (=12 hours per event/6 days per event = 2 hours perday). Based on interview
(2) 3 events per year, with each event occurring over a 6 day period (= 18 days per year). Based on interview (9/24/96).
MADEP, 1995. Guidance for Disposal Site Risk Characterization, Interim Final Policy WSC/ORS-95-141. July.
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors." OSWER Directive 9285.6-03.

EQUATIONS

CANCER RISK = AVG. CONC. (ug/m3) * CANCER UNIT RISK $(ug/m3)^{-1}$
HAZARD QUOTIENT = AVG.CONC.(ug/m3)/REF. CONC. (ug/m3)

$$\text{AVG. EXPOSURE CONC.} = \frac{[OHM]air * EF * ET * ED}{AT * CF1 * CF2}$$

Note:
*For noncarcinogenic effects: AT = ED

OFWALTIN
TABLE A8-2
INHALATION EXPOSURE TO VOLATILE OHM IN BUILDING AIR FROM PROCESS WATER (GROUNDWATER)
RECEPTOR: OFF-SITE WORKER

OLIN CORPORATION
WILMINGTON, MA FACILITY
19-Jun-97
CARCINOGENIC EFFECTS

| COMPOUND | | OHM AIR CONCENTRATION (mg/m$^3$) | AVERAGE AIR CONCENTRATION LIFETIME (mg/m3) | INHALATION CANCER UNIT RISK (mg/m3)$^{-1}$ | CANCER RISK |
|---|---|---|---|---|---|
| No potentially carcinogenic OHM of concern detected. | | | | | |
| | | | SUMMARY CANCER RISK | | 0E+00 |

ND = No data available.

OFWALTIN
TABLE A8-2
INHALATION EXPOSURE TO VOLATILE OHM IN BUILDING AIR FROM PROCESS WATER (GROUNDWATER)
RECEPTOR: OFF-SITE WORKER

OLIN CORPORATION
WILMINGTON, MA FACILITY
19-Jun-97

NONCARCINOGENIC EFFECTS

| COMPOUND | | OHM AIR CONCENTRATION (ug/m³) | AVERAGE AIR CONCENTRATION FOR TIME PERIOD (ug/m3) | CHRONIC INHALATION RfC [1] (ug/m3) | HAZARD QUOTIENT |
|---|---|---|---|---|---|
| 2,4,4-Trimethyl-1-pentene | | 0.46 | 1.1E-01 | 7.20E+02 | 1.5E-04 |
| 2,4,4-Trimethyl-2-pentene | | 0.11 | 2.5E-02 | 7.20E+02 | 3.5E-05 |
| Acetone | | 0.81 | 1.8E-01 | 8.00E+02 | 2.3E-04 |
| Nitrogen, Ammonia | | 330 | 7.5E+01 | 1.00E+02 | 7.5E-01 |
| | | | | | 8E-01 |

ND = No data available.

GWVPCUR
INHALATION EXPOSURE TO VOLATILE OHM IN BASEMENT AIR (MIGRATION FROM GROUNDWATER)
INDOOR WORKER (ON-SITE AND OFF-SITE COMBINED) - CURRENT SCENARIO
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A8-3

12-Jun-97

EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| CONCENTRATION IN AIR | [RP]air | Modeled | ug/m3 | |
| CONCENTRATION IN SOIL | [OHM]part | chemical-specific | mg/kg | |
| CONVERSION FACTOR 1 | CF1 | 24 | hours/day | |
| EXPOSURE TIME DAILY | ET | 8 | hours/day | Assumption |
| EXPOSURE FREQUENCY | EF | 250 | days/year | MADEP, 1995 |
| EXPOSURE DURATION | ED | 25 | years | USEPA, 1991 |
| CONVERSION FACTOR 2 | CF2 | 365 | days/year | |
| CONVERSION FACTOR 3 | CF3 | 0.000001 | kg/mg | |
| AVERAGING TIME CANCER | AT | 75 | years | MADEP, 1995 |
| AVERAGING TIME NONCANCER | AT | 25 | years | USEPA, 1991 |

MADEP, 1995. Guidance for Disposal Site Risk Characterization, Interim Final Policy WSC/ORS-95-141. July.
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors." OSWER Directive 9285.6-03.

EQUATIONS

CANCER RISK = AVG. CONC. (ug/m3) * CANCER UNIT RISK (ug/m3)^-1

HAZARD QUOTIENT = AVG.CONC.(ug/m3)/REF. CONC. (ug/m3)

$$\text{AVG. EXPOSURE CONC.} = \frac{[OHM]air * EF * ET * ED}{AT * CF1 * CF2}$$

OHM AIR CONC. = [RP]air * [OHM]part * CF3

Note:
*For noncarcinogenic effects: AT = ED

GWVPCUR
INHALATION EXPOSURE TO VOLATILE OHM IN BASEMENT AIR (MIGRATION FROM GROUNDWATER)
INDOOR WORKER (ON-SITE AND OFF-SITE COMBINED) - CURRENT SCENARIO
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A8-3

12-Jun-97

CARCINOGENIC EFFECTS

| COMPOUND | | OHM AIR CONCENTRATION (mg/m³) | AVERAGE AIR CONCENTRATION LIFETIME (ug/m3) | INHALATION CANCER UNIT RISK (ug/m3)^-1 | CANCER RISK |
|---|---|---|---|---|---|
| 1,1-Dichloroethane | | 1.00E-04 | 7.6E-06 | 1.60E-06 | 1.2E-11 |
| Bromoform | | 3.11E-05 | 2.4E-06 | 1.10E-06 | 2.6E-12 |
| Dibromochloromethane | | 1.56E-05 | 1.2E-06 | ND | |
| Methylene Chloride | | 5.90E-05 | 4.5E-06 | 4.70E-07 | 2.1E-12 |
| | | | SUMMARY CANCER RISK | | 2E-11 |

ND = No data available.

GWVPCUR
INHALATION EXPOSURE TO VOLATILE OHM IN BASEMENT AIR (MIGRATION FROM GROUNDWATER)
INDOOR WORKER (ON-SITE AND OFF-SITE COMBINED) - CURRENT SCENARIO
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A8-3

12-Jun-97
NONCARCINOGENIC EFFECTS

| COMPOUND | | OHM AIR CONCENTRATION (ug/m³) | AVERAGE AIR CONCENTRATION FOR TIME PERIOD (ug/m3) | CHRONIC INHALATION RfC [1] (ug/m3) | HAZARD QUOTIENT |
|---|---|---|---|---|---|
| 1,1,1-Trichloroethane | | 3.04E-03 | 6.9E-04 | 1.00E+03 | 6.9E-07 |
| 1,1-Dichloroethane | | 1.00E-04 | 2.3E-05 | 5.00E+02 | 4.6E-08 |
| 2,4,4-Trimethyl-1-pentene | | 1.57E+01 | 3.6E+00 | 7.20E+02 | 5.0E-03 |
| 2,4,4-Trimethyl-2-Pentene | | 3.30E+00 | 7.5E-01 | 7.20E+02 | 1.0E-03 |
| 2-Hexanone | | 2.25E-06 | 5.1E-07 | 5.00E+01 | 1.0E-08 |
| Acetone | | 4.53E-06 | 1.0E-06 | 8.00E+02 | 1.3E-09 |
| Bromoform | | 3.11E-05 | 7.1E-06 | 6.60E+02 | 1.1E-08 |
| Dibromochloromethane | | 1.56E-05 | 3.6E-06 | ND | |
| Methylene Chloride | | 5.90E-08 | 1.3E-08 | 3.00E+03 | 4.5E-12 |
| Ammonia | | 6.29E-01 | 1.4E-01 | 1.00E+02 | 1.4E-03 |
| | | | | | 7E-03 |

ND = No data available.

GWVPWC.XLS
INHALATION EXPOSURE TO VOLATILE OHM IN BASEMENT AIR (MIGRATION FROM GROUNDWATER)
INDOOR WORKER (ON-SITE AND OFF-SITE COMBINED) - FUTURE WORST CASE SCENARIO
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A8-4

EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| CONCENTRATION IN AIR | [RP]air | Modeled | ug/m3 | |
| CONCENTRATION IN SOIL | [OHM]part | chemical-specific | mg/kg | |
| CONVERSION FACTOR 1 | CF1 | 24 | hours/day | |
| EXPOSURE TIME DAILY | ET | 8 | hours/day | Assumption |
| EXPOSURE FREQUENCY | EF | 250 | days/year | MADEP, 1995 |
| EXPOSURE DURATION | ED | 25 | years | USEPA, 1991 |
| CONVERSION FACTOR 2 | CF2 | 365 | days/year | |
| CONVERSION FACTOR 3 | CF3 | 0.000001 | kg/mg | |
| AVERAGING TIME CANCER | AT | 75 | years | MADEP, 1995 |
| AVERAGING TIME NONCANCER | AT | 25 | years | USEPA, 1991 |

MADEP, 1995. Guidance for Disposal Site Risk Characterization, Interim Final Policy WSC/ORS-95-141. July.
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors." OSWER Directive 9285.6-03.

EQUATIONS

CANCER RISK = AVG. CONC. (ug/m3) * CANCER UNIT RISK (ug/m3)^-1

HAZARD QUOTIENT = AVG.CONC.(ug/m3)/REF. CONC. (ug/m3)

$$\text{AVG. EXPOSURE CONC.} \quad \frac{[\text{OHM}]\text{air} * \text{EF} * \text{ET} * \text{ED}}{\text{AT} * \text{CF1} * \text{CF2}}$$

OHM AIR CONC. = [RP]air * [OHM]part * CF3

Note:
*For noncarcinogenic effects: AT = ED

GWVPWC.XLS
.INHALATION EXPOSURE TO VOLATILE OHM IN BASEMENT AIR (MIGRATION FROM GROUNDWATER)
INDOOR WORKER (ON-SITE AND OFF-SITE COMBINED) - FUTURE WORST CASE SCENARIO
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A8-4

CARCINOGENIC EFFECTS

| COMPOUND | | OHM AIR CONCENTRATION (ug/m³) | AVERAGE AIR CONCENTRATION LIFETIME (ug/m3) | INHALATION CANCER UNIT RISK (ug/m3)^-1 | CANCER RISK |
|---|---|---|---|---|---|
| 1,1-Dichloroethane | | 3.00E-04 | 2.3E-05 | 1.60E-06 | 3.7E-11 |
| 1,1-Dichloroethene | | 6.97E-04 | 5.3E-05 | 5.00E-05 | 2.7E-09 |
| Bromoform | | 1.14E-04 | 8.7E-06 | 1.10E-06 | 9.5E-12 |
| Dibromochloromethane | | 5.45E-05 | 4.1E-06 | ND | |
| Methylene Chloride | | 5.90E-05 | 4.5E-06 | 4.70E-07 | 2.1E-12 |
| | | | | SUMMARY CANCER RISK | 3E-09 |

ND = No data available.

GWVPWC.XLS
INHALATION EXPOSURE TO VOLATILE OHM IN BASEMENT AIR (MIGRATION FROM GROUNDWATER)
INDOOR WORKER (ON-SITE AND OFF-SITE COMBINED) - FUTURE WORST CASE SCENARIO
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A8-4

NONCARCINOGENIC EFFECTS

| COMPOUND | | OHM AIR CONCENTRATION (ug/m³) | AVERAGE AIR CONCENTRATION FOR TIME PERIOD (ug/m3) | CHRONIC INHALATION RfC [1] (ug/m3) | HAZARD QUOTIENT |
|---|---|---|---|---|---|
| 1,1,1-Trichloroethane | | 2.89E-03 | 6.6E-04 | 1.00E+03 | 6.6E-07 |
| 1,1-Dichloroethane | | 3.00E-04 | 6.8E-05 | 5.00E+02 | 1.4E-07 |
| 1,1-Dichloroethene | | 6.97E-04 | 1.6E-04 | 5.00E+01 | 3.2E-06 |
| 2,4,4-Trimethyl-1-pentene | | 3.22E+02 | 7.4E+01 | 7.20E+02 | 1.0E-01 |
| 2,4,4-Trimethyl-2-Pentene | | 1.11E+02 | 2.5E+01 | 7.20E+02 | 3.5E-02 |
| 2-Hexanone | | 2.25E-06 | 5.1E-07 | 5.00E+01 | 1.0E-08 |
| Acetone | | 6.97E-04 | 1.6E-04 | 8.00E+02 | 2.0E-07 |
| Bromoform | | 1.14E-04 | 2.6E-05 | 6.60E+02 | 3.9E-08 |
| Carbon Disulfide | | 2.41E-03 | 5.5E-04 | 7.00E+02 | 7.9E-07 |
| Dibromochloromethane | | 6.29E-01 | 1.4E-01 | ND | |
| Methylene Chloride | | 5.90E-05 | 1.3E-05 | 3.00E+03 | 4.5E-09 |
| Toluene | | 5.90E-05 | 1.3E-05 | 4.00E+02 | 3.4E-08 |
| Ammonia | | 6.29E-01 | 1.4E-01 | 1.00E+02 | 1.4E-03 |
| | | | | | 1E-01 |

ND = No data available.

GWCRCURB
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
CHILD RESIDENT (AGES 1-6)
CURRENT CONDITIONS

TABLE A8-5

18-Jun-97

EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| Concentration in Ground Water | OHMgw | | mg/liter | Site-specific |
| Lifetime Average Daily Dose | LADD | calculated below | | MADEP, 1995 |
| Average Daily Dose | ADD | calculated below | | MADEP, 1995 |
| Ingestion Rate | IR | 1 | liters/day | MADEP, 1995 |
| Surface Area Exposed | SA | 6,224 | $cm^2$ | MADEP, 1995 |
| Body Weight | BW | 15 | kg | MADEP, 1995 |
| Conversion Factor | CF | 0.001 | liter/$cm^3$ | |
| Exposure Time | ET | 0.2 | hours/day | Assumption [1] |
| Exposure Frequency | EF | 350 | days/year | Site-specific |
| Exposure Period | EP | 6 | years | Site-specific |
| Averaging Time | | | | |
| Cancer | ATc | 75 | years | MADEP, 1995 |
| Noncancer | ATn | 6 | years | MADEP, 1995 |
| Relative Absorption Factor (RAF) | | | | |
| Oral | RAFo | listed below | unitless | MADEP, 1995 |
| Dermal | RAFd | listed below | unitless | MADEP, 1995 |
| Permeability Constant | Kp | listed below | cm/hour | MADEP, 1995 |

MADEP, 1995 "Guidance for Disposal Site Risk Characterization"
[1] Average time spent in shower

EQUATIONS

CANCER RISK = LADD (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = ADD (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{LADD-INGESTION} = \frac{\text{OHMgw x IR x RAFl x EF x EP}}{\text{BW x ATc x 365 days/yr}}$$

$$\text{ADD-INGESTION} = \frac{\text{OHMgw x IR x RAFl x EF x EP}}{\text{BW x ATn x 365 days/yr}}$$

$$\text{LADD-DERMAL} = \frac{\text{OHMgw x SA x Kp x RAFd x CF x ED x EF x EP}}{\text{BW x ATc x 365 days/yr}}$$

$$\text{ADD-DERMAL} = \frac{\text{OHMgw x SA x Kp x RAFd x CF x ED x EF x EP}}{\text{BW x ATn x 365 days/yr}}$$

Note:
For noncarcinogenic risk, AT = EP

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GWCRCURB.XLS
6/18/97 1:11 PM

GWCRCURB
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
CHILD RESIDENT (AGES 1-6)
CURRENT CONDITIONS

TABLE A8-5

18-Jun-97

CARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | RAFd | INTAKE DERMAL (mg/kg-day) | CANCER SLOPE FACTOR (mg/kg-day)^-1 | CANCER RISK INGESTION | CANCER RISK DERMAL | TOTAL CANCER RISK |
|---|---|---|---|---|---|---|---|---|---|---|
| No potentially carcinogenic OHM of concern were detected. | | | | | | | | | | |
| | | | | | | SUMMARY CANCER RISK | | 0E+00 | 0E+00 | 0E+00 |

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GWCRCURB
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
CHILD RESIDENT (AGES 1-6)
CURRENT CONDITIONS

TABLE A8-5

18-Jun-97
NONCARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | RAFd | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|---|
| Manganese | 0.0336 | 2 | 4.3E-03 | 0.001 | NA | 0.0E+00 | 0.047 | 9.1E-02 | 0.0E+00 | 9.1E-02 |
| Chloride | 78.4 | ND | | | NA | 0.0E+00 | ND | | 0.0E+00 | |
| Sulfate as SO4 | 79.5 | 0.73 | 3.7E+00 | 0.001 | NA | 0.0E+00 | 14 | 2.7E-01 | 0.0E+00 | 2.7E-01 |
| | | | | | | SUMMARY HAZARD INDEX | | 0.4 | 0 | 0.4 |

NA = Not applicable
Dermal exposures have not been calculated for inorganics per MADEP, 1995 "Guidance for Disposal Site Risk Characterization".

GWWKCURB
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
ADULT FULL-TIME WORKER
CURRENT CONDITIONS

TABLE A8-6

18-Jun-97

**EXPOSURE PARAMETERS**

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| Concentration in Ground Water | OHMgw | | mg/liter | Site-specific |
| Lifetime Average Daily Dose | LADD | calculated below | | MADEP, 1995 |
| Average Daily Dose | ADD | calculated below | | MADEP, 1995 |
| Ingestion Rate | IR | 1 | liters/day | Assumption, [1] |
| Surface Area Exposed | SA | | $cm^2$ | [2] |
| Body Weight | BW | 70 | kg | MADEP, 1995 |
| Conversion Factor | CF | 0.001 | $liter/cm^3$ | |
| Exposure Time | ET | | hours/day | [2] |
| Exposure Frequency | EF | 250 | days/year | Site-specific |
| Exposure Period | EP | 25 | years | Site-specific |
| Averaging Time | | | | |
| Cancer | ATc | 75 | years | MADEP, 1995 |
| Noncancer | ATn | 25 | years | MADEP, 1995 |
| Relative Absorption Factor (RAF) | | | | |
| Oral | RAFo | listed below | unitless | MADEP, 1995 |
| Dermal | RAFd | listed below | unitless | MADEP, 1995 |
| Permeability Constant | Kp | listed below | cm/hour | MADEP, 1995 |

MADEP, 1995 "Guidance for Disposal Site Risk Characterization"
[1] Assumes one-half the daily fluid intake is obtained from tap water at the workplace
[2] Worker does not shower and, therefore, dermal exposures are not evaluated

**EQUATIONS**

CANCER RISK = LADD (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = ADD (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{LADD-INGESTION} = \frac{OHMgw \times IR \times RAFI \times EF \times EP}{BW \times ATc \times 365\ days/yr}$$

$$\text{ADD-INGESTION} = \frac{OHMgw \times IR \times RAFI \times EF \times EP}{BW \times ATn \times 365\ days/yr}$$

$$\text{LADD-DERMAL} = \frac{OHMgw \times SA \times Kp \times RAFd \times CF \times ED \times EF \times EP}{BW \times ATc \times 365\ days/yr}$$

$$\text{ADD-DERMAL} = \frac{OHMgw \times SA \times Kp \times RAFd \times CF \times ED \times EF \times EP}{BW \times ATn \times 365\ days/yr}$$

Note:
For noncarcinogenic risk, AT = EP

GWWKCURB
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
ADULT FULL-TIME WORKER
CURRENT CONDITIONS

TABLE A8-6

18-Jun-97

CARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | RAFd | INTAKE DERMAL (mg/kg-day) | CANCER SLOPE FACTOR (mg/kg-day)^-1 | CANCER RISK INGESTION | CANCER RISK DERMAL | TOTAL CANCER RISK |
|---|---|---|---|---|---|---|---|---|---|---|
| No potentially carcinogenic OHM of concern were detected. | | | | | | | | | | |
| | | | | | | SUMMARY CANCER RISK | | 0E+00 | 0E+00 | 0E+00 |

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GWWKCURB.XLS
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GWWKCURB
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
ADULT FULL-TIME WORKER
CURRENT CONDITIONS

TABLE A8-6

18-Jun-97
NONCARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | RAFd | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|---|
| Manganese | 0.0336 | 2 | 6.6E-04 | 0.001 | NA | 0.0E+00 | 0.047 | 1.4E-02 | 0.0E+00 | 1.4E-02 |
| Chloride | 78.4 | ND | | | NA | 0.0E+00 | ND | | 0.0E+00 | |
| Sulfate as SO4 | 79.5 | 0.73 | 5.7E-01 | 0.001 | NA | 0.0E+00 | 14 | 4.1E-02 | 0.0E+00 | 4.1E-02 |
| | | | | | | SUMMARY HAZARD INDEX | | 0.05 | 0 | 0.05 |

NA = Not applicable
Dermal exposures have not been calculated for inorganics per MADEP, 1995 "Guidance for Disposal Site Risk Characterization".

GWCRFAWW
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
CHILD RESIDENT (AGES 1-6)
FUTURE CONDITIONS; ALL WELLS PUMPING (WITHOUT WELL GW-83-D) - WET SEASON

TABLE A8-7

19-Jun-97

EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| Concentration in Ground Water | OHMgw | | mg/liter | Site-specific |
| Lifetime Average Daily Dose | LADD | calculated below | | MADEP, 1995 |
| Average Daily Dose | ADD | calculated below | | MADEP, 1995 |
| Ingestion Rate | IR | 1 | liters/day | MADEP, 1995 |
| Surface Area Exposed | SA | 6,224 | $cm^2$ | MADEP, 1995 |
| Body Weight | BW | 15 | kg | MADEP, 1995 |
| Conversion Factor | CF | 0.001 | liter/$cm^3$ | |
| Exposure Time | ET | 0.2 | hours/day | Assumption [1] |
| Exposure Frequency | EF | 350 | days/year | Site-specific |
| Exposure Period | EP | 6 | years | Site-specific |
| Averaging Time | | | | |
| Cancer | ATc | 75 | years | MADEP, 1995 |
| Noncancer | ATn | 6 | years | MADEP, 1995 |
| Relative Absorption Factor (RAF) | | | | |
| Oral | RAFo | listed below | unitless | MADEP, 1995 |
| Dermal | RAFd | listed below | unitless | MADEP, 1995 |
| Permeability Constant | Kp | listed below | cm/hour | MADEP, 1995 |

MADEP, 1995 "Guidance for Disposal Site Risk Characterization"
[1] Average time spent in shower

EQUATIONS

CANCER RISK = LADD (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = ADD (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{LADD-INGESTION} = \frac{OHMgw \times IR \times RAFi \times EF \times EP}{BW \times ATc \times 365\ days/yr}$$

$$\text{ADD-INGESTION} = \frac{OHMgw \times IR \times RAFi \times EF \times EP}{BW \times ATn \times 365\ days/yr}$$

$$\text{LADD-DERMAL} = \frac{OHMgw \times SA \times Kp \times RAFd \times CF \times ED \times EF \times EP}{BW \times ATc \times 365\ days/yr}$$

$$\text{ADD-DERMAL} = \frac{OHMgw \times SA \times Kp \times RAFd \times CF \times ED \times EF \times EP}{BW \times ATn \times 365\ days/yr}$$

Note:
For noncarcinogenic risk, AT = EP

GWCRFAWW
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
CHILD RESIDENT (AGES 1-6)
FUTURE CONDITIONS; ALL WELLS PUMPING (WITHOUT WELL GW-83-D) - WET SEASON

TABLE A8-7

19-Jun-97

CARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | RAFd | INTAKE DERMAL (mg/kg-day) | CANCER SLOPE FACTOR (mg/kg-day)^-1 | CANCER RISK INGESTION | CANCER RISK DERMAL | TOTAL CANCER RISK |
|---|---|---|---|---|---|---|---|---|---|---|
| No potentially carcinogenic OHM of concern were detected. | | | | | | | | | | |
| | | | | | | SUMMARY CANCER RISK | | 0E+00 | 0E+00 | 0E+00 |

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GWCRFAWW
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
CHILD RESIDENT (AGES 1-6)
FUTURE CONDITIONS; ALL WELLS PUMPING (WITHOUT WELL GW-83-D) - WET SEASON

TABLE A8-7

19-Jun-97
NONCARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | RAFd | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|---|
| Manganese | 0.0336 | 2 | 4.3E-03 | 0.001 | NA | 0.0E+00 | 0.047 | 9.1E-02 | 0.0E+00 | 9.1E-02 |
| Chloride | 71.8 | ND | | | NA | 0.0E+00 | ND | | 0.0E+00 | |
| Sulfate as SO4 | 81.3 | 0.73 | 3.8E+00 | 0.001 | NA | 0.0E+00 | 14 | 2.7E-01 | 0.0E+00 | 2.7E-01 |
| Sodium | 37.5 | ND | | | NA | 0.0E+00 | ND | | 0.0E+00 | |
| | | | | | | | SUMMARY HAZARD INDEX | 0.4 | 0 | 0.4 |

NA = Not applicable
Dermal exposures have not been calculated for inorganics per MADEP, 1995 "Guidance for Disposal Site Risk Characterization".

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GWCRF83W
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
CHILD RESIDENT (AGES 1-6)
FUTURE CONDITIONS; ALL WELLS PUMPING (INCLUDING WELL 83-d) - WET SEASON

TABLE A8-8

19-Jun-97

EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| **Concentration in Ground Water** | OHMgw | | mg/liter | Site-specific |
| **Lifetime Average Daily Dose** | LADD | calculated below | | MADEP, 1995 |
| **Average Daily Dose** | ADD | calculated below | | MADEP, 1995 |
| **Ingestion Rate** | IR | 1 | liters/day | MADEP, 1995 |
| **Surface Area Exposed** | SA | 6,224 | $cm^2$ | MADEP, 1995 |
| **Body Weight** | BW | 15 | kg | MADEP, 1995 |
| **Conversion Factor** | CF | 0.001 | liter/$cm^3$ | |
| **Exposure Time** | ET | 0.2 | hours/day | Assumption [1] |
| **Exposure Frequency** | EF | 350 | days/year | Site-specific |
| **Exposure Period** | EP | 6 | years | Site-specific |
| **Averaging Time** | | | | |
| **Cancer** | ATc | 75 | years | MADEP, 1995 |
| **Noncancer** | ATn | 6 | years | MADEP, 1995 |
| **Relative Absorption Factor (RAF)** | | | | |
| **Oral** | RAFo | listed below | unitless | MADEP, 1995 |
| **Dermal** | RAFd | listed below | unitless | MADEP, 1995 |
| **Permeability Constant** | Kp | listed below | cm/hour | MADEP, 1995 |

MADEP, 1995 "Guidance for Disposal Site Risk Characterization"
[1] Average time spent in shower

EQUATIONS

CANCER RISK = LADD (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = ADD (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{LADD-INGESTION} = \frac{OHMgw \times IR \times RAFi \times EF \times EP}{BW \times ATc \times 365\ days/yr}$$

$$\text{ADD-INGESTION} = \frac{OHMgw \times IR \times RAFi \times EF \times EP}{BW \times ATn \times 365\ days/yr}$$

$$\text{LADD-DERMAL} = \frac{OHMgw \times SA \times Kp \times RAFd \times CF \times ED \times EF \times EP}{BW \times ATc \times 365\ days/yr}$$

$$\text{ADD-DERMAL} = \frac{OHMgw \times SA \times Kp \times RAFd \times CF \times ED \times EF \times EP}{BW \times ATn \times 365\ days/yr}$$

Note:
For noncarcinogenic risk, AT = EP

GWCRF83W
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
CHILD RESIDENT (AGES 1-6)
FUTURE CONDITIONS; ALL WELLS PUMPING (INCLUDING WELL 83-d) - WET SEASON

TABLE A8-8

19-Jun-97
CARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | RAFd | INTAKE DERMAL (mg/kg-day) | CANCER SLOPE FACTOR (mg/kg-day)^-1 | CANCER RISK INGESTION | CANCER RISK DERMAL | TOTAL CANCER RISK |
|---|---|---|---|---|---|---|---|---|---|---|
| No potentially carcinogenic OHM of concern were detected. | | | | | | | | | | |
| | | | | | | SUMMARY CANCER RISK | | 0E+00 | 0E+00 | 0E+00 |

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GWCRF83W
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
CHILD RESIDENT (AGES 1-6)
FUTURE CONDITIONS; ALL WELLS PUMPING (INCLUDING WELL 83-d) - WET SEASON

TABLE A8-8

19-Jun-97
NONCARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | RAFd | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|---|
| Manganese | 0.0336 | 2 | 4.3E-03 | 0.001 | NA | 0.0E+00 | 0.047 | 9.1E-02 | 0.0E+00 | 9.1E-02 |
| Chloride | 112.5 | ND | | | NA | 0.0E+00 | ND | | 0.0E+00 | |
| Sulfate as SO4 | 234.4 | 0.73 | 1.1E+01 | 0.001 | NA | 0.0E+00 | 14 | 7.8E-01 | 0.0E+00 | 7.8E-01 |
| Sodium | 91.3 | ND | | | NA | 0.0E+00 | ND | | 0.0E+00 | |
| | | | | | | SUMMARY HAZARD INDEX | | 0.9 | 0 | 0.9 |

NA = Not applicable
Dermal exposures have not been calculated for inorganics per MADEP, 1995 "Guidance for Disposal Site Risk Characterization".

GWCRFAWD
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
CHILD RESIDENT (AGES 1-6)
FUTURE CONDITIONS; ALL WELLS PUMPING - DRY SEASON

TABLE A8-9

19-Jun-97

EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| Concentration in Ground Water | OHMgw | | mg/liter | Site-specific |
| Lifetime Average Daily Dose | LADD | calculated below | | MADEP, 1995 |
| Average Daily Dose | ADD | calculated below | | MADEP, 1995 |
| Ingestion Rate | IR | 1 | liters/day | MADEP, 1995 |
| Surface Area Exposed | SA | 6,224 | $cm^2$ | MADEP, 1995 |
| Body Weight | BW | 15 | kg | MADEP, 1995 |
| Conversion Factor | CF | 0.001 | liter/$cm^3$ | |
| Exposure Time | ET | 0.2 | hours/day | Assumption [1] |
| Exposure Frequency | EF | 350 | days/year | Site-specific |
| Exposure Period | EP | 6 | years | Site-specific |
| Averaging Time | | | | |
| Cancer | ATc | 75 | years | MADEP, 1995 |
| Noncancer | ATn | 6 | years | MADEP, 1995 |
| Relative Absorption Factor (RAF) | | | | |
| Oral | RAFo | listed below | unitless | MADEP, 1995 |
| Dermal | RAFd | listed below | unitless | MADEP, 1995 |
| Permeability Constant | Kp | listed below | cm/hour | MADEP, 1995 |

MADEP, 1995 "Guidance for Disposal Site Risk Characterization"
[1] Average time spent in shower

EQUATIONS

CANCER RISK = LADD (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)^-1

HAZARD QUOTIENT = ADD (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{LADD-INGESTION} = \frac{\text{OHMgw x IR x RAFi x EF x EP}}{\text{BW x ATc x 365 days/yr}}$$

$$\text{ADD-INGESTION} = \frac{\text{OHMgw x IR x RAFi x EF x EP}}{\text{BW x ATn x 365 days/yr}}$$

$$\text{LADD-DERMAL} = \frac{\text{OHMgw x SA x Kp x RAFd x CF x ED x EF x EP}}{\text{BW x ATc x 365 days/yr}}$$

$$\text{ADD-DERMAL} = \frac{\text{OHMgw x SA x Kp x RAFd x CF x ED x EF x EP}}{\text{BW x ATn x 365 days/yr}}$$

Note:
For noncarcinogenic risk, AT = EP

GWCRFAWD
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
CHILD RESIDENT (AGES 1-6)
FUTURE CONDITIONS; ALL WELLS PUMPING - DRY SEASON

TABLE A8-9

19-Jun-97

CARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | RAFd | INTAKE DERMAL (mg/kg-day) | CANCER SLOPE FACTOR (mg/kg-day)^-1 | CANCER RISK INGESTION | CANCER RISK DERMAL | TOTAL CANCER RISK |
|---|---|---|---|---|---|---|---|---|---|---|
| No potentially carcinogenic OHM of concern were detected. | | | | | | | | | | |
| | | | | | | | SUMMARY CANCER RISK | 0E+00 | 0E+00 | 0E+00 |

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GWCRFAWD
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
CHILD RESIDENT (AGES 1-6)
FUTURE CONDITIONS; ALL WELLS PUMPING - DRY SEASON

TABLE A8-9

19-Jun-97
NONCARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | RAFd | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|---|
| Manganese | 0.0336 | 2 | 4.3E-03 | 0.001 | NA | 0.0E+00 | 0.047 | 9.1E-02 | 0.0E+00 | 9.1E-02 |
| Chloride | 80.5 | ND | | | NA | 0.0E+00 | ND | | 0.0E+00 | |
| Sulfate as SO4 | 109 | 0.73 | 5.1E+00 | 0.001 | NA | 0.0E+00 | 14 | 3.6E-01 | 0.0E+00 | 3.6E-01 |
| Sodium | 41.4 | ND | | | NA | 0.0E+00 | ND | | 0.0E+00 | |
| | | | | | | SUMMARY HAZARD INDEX | | 0.5 | 0 | 0.5 |

NA = Not applicable
Dermal exposures have not been calculated for inorganics per MADEP, 1995 "Guidance for Disposal Site Risk Characterization".

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GWCRFBWW
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
CHILD RESIDENT (AGES 1-6)
FUTURE CONDITIONS; BUTTERS ROW #1 PUMPING - WET SEASON

TABLE A8-10

18-Jun-97

EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| Concentration in Ground Water | OHMgw | | mg/liter | Site-specific |
| Lifetime Average Daily Dose | LADD | calculated below | | MADEP, 1995 |
| Average Daily Dose | ADD | calculated below | | MADEP, 1995 |
| Ingestion Rate | IR | 1 | liters/day | MADEP, 1995 |
| Surface Area Exposed | SA | 6,224 | $cm^2$ | MADEP, 1995 |
| Body Weight | BW | 15 | kg | MADEP, 1995 |
| Conversion Factor | CF | 0.001 | liter/$cm^3$ | |
| Exposure Time | ET | 0.2 | hours/day | Assumption [1] |
| Exposure Frequency | EF | 350 | days/year | Site-specific |
| Exposure Period | EP | 6 | years | Site-specific |
| Averaging Time | | | | |
| Cancer | ATc | 75 | years | MADEP, 1995 |
| Noncancer | ATn | 6 | years | MADEP, 1995 |
| Relative Absorption Factor (RAF) | | | | |
| Oral | RAFo | listed below | unitless | MADEP, 1995 |
| Dermal | RAFd | listed below | unitless | MADEP, 1995 |
| Permeability Constant | Kp | listed below | cm/hour | MADEP, 1995 |

MADEP, 1995 "Guidance for Disposal Site Risk Characterization"
[1] Average time spent in shower

EQUATIONS

CANCER RISK = LADD (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)^-1

HAZARD QUOTIENT = ADD (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{LADD-INGESTION} = \frac{\text{OHMgw x IR x RAFl x EF x EP}}{\text{BW x ATc x 365 days/yr}}$$

$$\text{ADD-INGESTION} = \frac{\text{OHMgw x IR x RAFl x EF x EP}}{\text{BW x ATn x 365 days/yr}}$$

$$\text{LADD-DERMAL} = \frac{\text{OHMgw x SA x Kp x RAFd x CF x ED x EF x EP}}{\text{BW x ATc x 365 days/yr}}$$

$$\text{ADD-DERMAL} = \frac{\text{OHMgw x SA x Kp x RAFd x CF x ED x EF x EP}}{\text{BW x ATn x 365 days/yr}}$$

Note:
For noncarcinogenic risk, AT = EP

GWCRFBWW
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
CHILD RESIDENT (AGES 1-6)
FUTURE CONDITIONS; BUTTERS ROW #1 PUMPING - WET SEASON

TABLE A8-10

18-Jun-97

CARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | RAFd | INTAKE DERMAL (mg/kg-day) | CANCER SLOPE FACTOR (mg/kg-day)^-1 | CANCER RISK INGESTION | CANCER RISK DERMAL | TOTAL CANCER RISK |
|---|---|---|---|---|---|---|---|---|---|---|
| No potentially carcinogenic OHM of concern were detected. | | | | | | | | | | |
| | | | | | | SUMMARY CANCER RISK | | 0E+00 | 0E+00 | 0E+00 |

ABB Environmental Services, Inc.
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GWCRFBWW
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
CHILD RESIDENT (AGES 1-6)
FUTURE CONDITIONS; BUTTERS ROW #1 PUMPING - WET SEASON

TABLE A8-10

19-Jun-97
NONCARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | RAFd | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|---|
| Manganese | 0.0336 | 2 | 4.3E-03 | 0.001 | NA | 0.0E+00 | 0.047 | 9.1E-02 | 0.0E+00 | 9.1E-02 |
| Chloride | 90 | ND | | | NA | 0.0E+00 | ND | | 0.0E+00 | |
| Sulfate as SO4 | 113 | 0.73 | 5.3E+00 | 0.001 | NA | 0.0E+00 | 14 | 3.8E-01 | 0.0E+00 | 3.8E-01 |
| Sodium | 46 | ND | | | NA | 0.0E+00 | ND | | 0.0E+00 | |
| | | | | | | | SUMMARY HAZARD INDEX | 0.5 | 0 | 0.5 |

NA = Not applicable
Dermal exposures have not been calculated for inorganics per MADEP, 1995 "Guidance for Disposal Site Risk Characterization".

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GWCRFBWD
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
CHILD RESIDENT (AGES 1-6)
FUTURE CONDITIONS; BUTTERS ROW #1 PUMPING - DRY SEASON

TABLE A8-11

19-Jun-97

EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| Concentration in Ground Water | OHMgw | | mg/liter | Site-specific |
| Lifetime Average Daily Dose | LADD | calculated below | | MADEP, 1995 |
| Average Daily Dose | ADD | calculated below | | MADEP, 1995 |
| Ingestion Rate | IR | 1 | liters/day | MADEP, 1995 |
| Surface Area Exposed | SA | 6,224 | $cm^2$ | MADEP, 1995 |
| Body Weight | BW | 15 | kg | MADEP, 1995 |
| Conversion Factor | CF | 0.001 | liter/$cm^3$ | |
| Exposure Time | ET | 0.2 | hours/day | Assumption [1] |
| Exposure Frequency | EF | 350 | days/year | Site-specific |
| Exposure Period | EP | 6 | years | Site-specific |
| Averaging Time | | | | |
| Cancer | ATc | 75 | years | MADEP, 1995 |
| Noncancer | ATn | 6 | years | MADEP, 1995 |
| Relative Absorption Factor (RAF) | | | | |
| Oral | RAFo | listed below | unitless | MADEP, 1995 |
| Dermal | RAFd | listed below | unitless | MADEP, 1995 |
| Permeability Constant | Kp | listed below | cm/hour | MADEP, 1995 |

MADEP, 1995 "Guidance for Disposal Site Risk Characterization"
[1] Average time spent in shower

EQUATIONS

CANCER RISK = LADD (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)^-1

HAZARD QUOTIENT = ADD (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{LADD-INGESTION} = \frac{\text{OHMgw x IR x RAFI x EF x EP}}{\text{BW x ATc x 365 days/yr}}$$

$$\text{ADD-INGESTION} = \frac{\text{OHMgw x IR x RAFI x EF x EP}}{\text{BW x ATn x 365 days/yr}}$$

$$\text{LADD-DERMAL} = \frac{\text{OHMgw x SA x Kp x RAFd x CF x ED x EF x EP}}{\text{BW x ATc x 365 days/yr}}$$

$$\text{ADD-DERMAL} = \frac{\text{OHMgw x SA x Kp x RAFd x CF x ED x EF x EP}}{\text{BW x ATn x 365 days/yr}}$$

Note:
For noncarcinogenic risk, AT = EP

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GWCRFBWD
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
CHILD RESIDENT (AGES 1-6)
FUTURE CONDITIONS; BUTTERS ROW #1 PUMPING - DRY SEASON

TABLE A8-11

19-Jun-97

CARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | RAFd | INTAKE DERMAL (mg/kg-day) | CANCER SLOPE FACTOR (mg/kg-day)^-1 | CANCER RISK INGESTION | CANCER RISK DERMAL | TOTAL CANCER RISK |
|---|---|---|---|---|---|---|---|---|---|---|
| No potentially carcinogenic OHM of concern were detected. | | | | | | | | | | |
| | | | | | | SUMMARY CANCER RISK | | 0E+00 | 0E+00 | 0E+00 |

ABB Environmental Services, Inc.
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GWCRFBWD
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
CHILD RESIDENT (AGES 1-6)
FUTURE CONDITIONS; BUTTERS ROW #1 PUMPING - DRY SEASON

TABLE A8-11

19-Jun-97

NONCARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | RAFd | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|---|
| Manganese | 0.0336 | 2 | 4.3E-03 | 0.001 | NA | 0.0E+00 | 0.047 | 9.1E-02 | 0.0E+00 | 9.1E-02 |
| Chloride | 79 | ND | | | NA | 0.0E+00 | ND | | 0.0E+00 | |
| Sulfate as SO4 | 82 | 0.73 | 3.8E+00 | 0.001 | NA | 0.0E+00 | 14 | 2.7E-01 | 0.0E+00 | 2.7E-01 |
| Sodium | 40 | ND | | | NA | 0.0E+00 | ND | | 0.0E+00 | |
| | | | | | | SUMMARY HAZARD INDEX | | 0.4 | 0 | 0.4 |

NA = Not applicable

Dermal exposures have not been calculated for inorganics per MADEP, 1995 "Guidance for Disposal Site Risk Characterization".

GWWKFAWW
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
ADULT FULL-TIME WORKER
FUTURE CONDITIONS; ALL WELLS PUMPING (WITHOUT WELL GW-83-D) - WET SEASON

TABLE A8-12

19-Jun-97

EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| Concentration in Ground Water | OHMgw | | mg/liter | Site-specific |
| Lifetime Average Daily Dose | LADD | calculated below | | MADEP, 1995 |
| Average Daily Dose | ADD | calculated below | | MADEP, 1995 |
| Ingestion Rate | IR | 1 | liters/day | Assumption, [1] |
| Surface Area Exposed | SA | | $cm^2$ | [2] |
| Body Weight | BW | 70 | kg | MADEP, 1995 |
| Conversion Factor | CF | 0.001 | liter/$cm^3$ | |
| Exposure Time | ET | | hours/day | [2] |
| Exposure Frequency | EF | 250 | days/year | Site-specific |
| Exposure Period | EP | 25 | years | Site-specific |
| Averaging Time | | | | |
| Cancer | ATc | 75 | years | MADEP, 1995 |
| Noncancer | ATn | 25 | years | MADEP, 1995 |
| Relative Absorption Factor (RAF) | | | | |
| Oral | RAFo | listed below | unitless | MADEP, 1995 |
| Dermal | RAFd | listed below | unitless | MADEP, 1995 |
| Permeability Constant | Kp | listed below | cm/hour | MADEP, 1995 |

MADEP, 1995 "Guidance for Disposal Site Risk Characterization"
[1] Assumes one-half the daily fluid intake is obtained from tap water at the workplace
[2] Worker does not shower and, therefore, dermal exposures are not evaluated

EQUATIONS

CANCER RISK = LADD (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)^-1

HAZARD QUOTIENT = ADD (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{LADD-INGESTION} = \frac{\text{OHMgw x IR x RAFl x EF x EP}}{\text{BW x ATc x 365 days/yr}}$$

$$\text{ADD-INGESTION} = \frac{\text{OHMgw x IR x RAFl x EF x EP}}{\text{BW x ATn x 365 days/yr}}$$

$$\text{LADD-DERMAL} = \frac{\text{OHMgw x SA x Kp x RAFd x CF x ED x EF x EP}}{\text{BW x ATc x 365 days/yr}}$$

$$\text{ADD-DERMAL} = \frac{\text{OHMgw x SA x Kp x RAFd x CF x ED x EF x EP}}{\text{BW x ATn x 365 days/yr}}$$

Note:
For noncarcinogenic risk, AT = EP

GWWKFAWW
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
ADULT FULL-TIME WORKER
FUTURE CONDITIONS; ALL WELLS PUMPING (WITHOUT WELL GW-83-D) - WET SEASON

TABLE A8-12

19-Jun-97

CARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | RAFd | INTAKE DERMAL (mg/kg-day) | CANCER SLOPE FACTOR (mg/kg-day)^-1 | CANCER RISK INGESTION | CANCER RISK DERMAL | TOTAL CANCER RISK |
|---|---|---|---|---|---|---|---|---|---|---|
| No potentially carcinogenic OHM of concern were detected. | | | | | | | | | | |
| | | | | | | SUMMARY CANCER RISK | | 0E+00 | 0E+00 | 0E+00 |

ABB Environmental Services, Inc.
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6/19/97 9:14 AM

GWWKFAWW
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
ADULT FULL-TIME WORKER
FUTURE CONDITIONS; ALL WELLS PUMPING (WITHOUT WELL GW-83-D) - WET SEASON

TABLE A8-12

19-Jun-97
NONCARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | RAFd | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|---|
| Manganese | 0.0336 | 2 | 6.6E-04 | 0.001 | NA | 0.0E+00 | 0.047 | 1.4E-02 | 0.0E+00 | 1.4E-02 |
| Chloride | 71.8 | ND | | | NA | 0.0E+00 | ND | | 0.0E+00 | |
| Sulfate as SO4 | 81.3 | 0.73 | 5.8E-01 | 0.001 | NA | 0.0E+00 | 14 | 4.1E-02 | 0.0E+00 | 4.1E-02 |
| Sodium | 37.5 | ND | | | NA | 0.0E+00 | | | 0.0E+00 | |
| | | | | | | SUMMARY HAZARD INDEX | | 0.06 | 0 | 0.06 |

NA = Not applicable
Dermal exposures have not been calculated for inorganics per MADEP, 1995 "Guidance for Disposal Site Risk Characterization".

GWWKF83W

INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT

ADULT FULL-TIME WORKER

FUTURE CONDITIONS; ALL WELL PUMPING (INCLUDING WELL GW-83-d)- WET SEASON

TABLE A8-13

18-Jun-97

**EXPOSURE PARAMETERS**

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| Concentration in Ground Water | OHMgw | | mg/liter | Site-specific |
| Lifetime Average Daily Dose | LADD | calculated below | | MADEP, 1995 |
| Average Daily Dose | ADD | calculated below | | MADEP, 1995 |
| Ingestion Rate | IR | 1 | liters/day | Assumption, [1] |
| Surface Area Exposed | SA | | $cm^2$ | [2] |
| Body Weight | BW | 70 | kg | MADEP, 1995 |
| Conversion Factor | CF | 0.001 | liter/$cm^3$ | |
| Exposure Time | ET | | hours/day | [2] |
| Exposure Frequency | EF | 250 | days/year | Site-specific |
| Exposure Period | EP | 25 | years | Site-specific |
| Averaging Time | | | | |
| Cancer | ATc | 75 | years | MADEP, 1995 |
| Noncancer | ATn | 25 | years | MADEP, 1995 |
| Relative Absorption Factor (RAF) | | | | |
| Oral | RAFo | listed below | unitless | MADEP, 1995 |
| Dermal | RAFd | listed below | unitless | MADEP, 1995 |
| Permeability Constant | Kp | listed below | cm/hour | MADEP, 1995 |

MADEP, 1995 "Guidance for Disposal Site Risk Characterization"

[1] Assumes one-half the daily fluid intake is obtained from tap water at the workplace

[2] Worker does not shower and, therefore, dermal exposures are not evaluated

**EQUATIONS**

CANCER RISK = LADD (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)^-1

HAZARD QUOTIENT = ADD (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{LADD-INGESTION} = \frac{\text{OHMgw x IR x RAFl x EF x EP}}{\text{BW x ATc x 365 days/yr}}$$

$$\text{ADD-INGESTION} = \frac{\text{OHMgw x IR x RAFl x EF x EP}}{\text{BW x ATn x 365 days/yr}}$$

$$\text{LADD-DERMAL} = \frac{\text{OHMgw x SA x Kp x RAFd x CF x ED x EF x EP}}{\text{BW x ATc x 365 days/yr}}$$

$$\text{ADD-DERMAL} = \frac{\text{OHMgw x SA x Kp x RAFd x CF x ED x EF x EP}}{\text{BW x ATn x 365 days/yr}}$$

Note:

For noncarcinogenic risk, AT = EP

ABB Environmental Services, Inc.

GWWKF83W.XLS

6/18/97 1:24 PM

GWWKF83W
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
ADULT FULL-TIME WORKER
FUTURE CONDITIONS; ALL WELL PUMPING (INCLUDING WELL GW-83-d)- WET SEASON

TABLE A8-13

18-Jun-97

CARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | RAFd | INTAKE DERMAL (mg/kg-day) | CANCER SLOPE FACTOR (mg/kg-day)^-1 | CANCER RISK INGESTION | CANCER RISK DERMAL | TOTAL CANCER RISK |
|---|---|---|---|---|---|---|---|---|---|---|
| No potentially carcinogenic OHM of concern were detected. | | | | | | | | | | |
| | | | | | | SUMMARY CANCER RISK | | 0E+00 | 0E+00 | 0E+00 |

ABB Environmental Services, Inc.
GWWKF83W.XLS
6/18/97 1:24 PM

GWWKF83W
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
ADULT FULL-TIME WORKER
FUTURE CONDITIONS; ALL WELL PUMPING (INCLUDING WELL GW-83-d)- WET SEASON

TABLE A8-13

19-Jun-97
NONCARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | RAFd | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|---|
| Manganese | 0.0336 | 2 | 6.6E-04 | 0.001 | NA | 0.0E+00 | 0.047 | 1.4E-02 | 0.0E+00 | 1.4E-02 |
| Chloride | 112.5 | ND | | | NA | 0.0E+00 | ND | | 0.0E+00 | |
| Sulfate as SO4 | 234.4 | 0.73 | 1.7E+00 | 0.001 | NA | 0.0E+00 | 14 | 1.2E-01 | 0.0E+00 | 1.2E-01 |
| Sodium | 91.3 | ND | | | NA | 0.0E+00 | | | 0.0E+00 | |
| | | | | | | SUMMARY HAZARD INDEX | | 0.13 | 0 | 0.13 |

NA = Not applicable
Dermal exposures have not been calculated for inorganics per MADEP, 1995 "Guidance for Disposal Site Risk Characterization".

GWWKFAWD
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
ADULT WORKER
FUTURE CONDITIONS; ALL WELLS PUMPING - DRY SEASON

TABLE A8-14

18-Jun-97

EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| Concentration in Ground Water | OHMgw | | mg/liter | Site-specific |
| Lifetime Average Daily Dose | LADD | calculated below | | MADEP, 1995 |
| Average Daily Dose | ADD | calculated below | | MADEP, 1995 |
| Ingestion Rate | IR | 1 | liters/day | MADEP, 1995 |
| Surface Area Exposed | SA | NA | $cm^2$ | MADEP, 1995 |
| Body Weight | BW | 70 | kg | MADEP, 1995 |
| Conversion Factor | CF | 0.001 | $liter/cm^3$ | |
| Exposure Time | ET | NA | hours/day | Assumption [1] |
| Exposure Frequency | EF | 250 | days/year | Site-specific |
| Exposure Period | EP | 25 | years | Site-specific |
| Averaging Time | | | | |
| Cancer | ATc | 75 | years | MADEP, 1995 |
| Noncancer | ATn | 25 | years | MADEP, 1995 |
| Relative Absorption Factor (RAF) | | | | |
| Oral | RAFo | listed below | unitless | MADEP, 1995 |
| Dermal | RAFd | listed below | unitless | MADEP, 1995 |
| Permeability Constant | Kp | listed below | cm/hour | MADEP, 1995 |

MADEP, 1995 "Guidance for Disposal Site Risk Characterization"
[1] Average time spent in shower

EQUATIONS

CANCER RISK = LADD (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)^-1

HAZARD QUOTIENT = ADD (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{LADD-INGESTION} = \frac{\text{OHMgw x IR x RAFl x EF x EP}}{\text{BW x ATc x 365 days/yr}}$$

$$\text{ADD-INGESTION} = \frac{\text{OHMgw x IR x RAFl x EF x EP}}{\text{BW x ATn x 365 days/yr}}$$

$$\text{LADD-DERMAL} = \frac{\text{OHMgw x SA x Kp x RAFd x CF x ED x EF x EP}}{\text{BW x ATc x 365 days/yr}}$$

$$\text{ADD-DERMAL} = \frac{\text{OHMgw x SA x Kp x RAFd x CF x ED x EF x EP}}{\text{BW x ATn x 365 days/yr}}$$

Note:
For noncarcinogenic risk, AT = EP

GWWKFAWD
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
ADULT WORKER
FUTURE CONDITIONS; ALL WELLS PUMPING - DRY SEASON

TABLE A8-14

18-Jun-97

CARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | RAFd | INTAKE DERMAL (mg/kg-day) | CANCER SLOPE FACTOR (mg/kg-day)^-1 | CANCER RISK INGESTION | CANCER RISK DERMAL | TOTAL CANCER RISK |
|---|---|---|---|---|---|---|---|---|---|---|
| No potentially carcinogenic OHM of concern were detected. | | | | | | | | | | |
| | | | | | | | SUMMARY CANCER RISK | 0E+00 | 0E+00 | 0E+00 |

ABB Environmental Services, Inc.
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GWWKFAWD
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
ADULT WORKER
FUTURE CONDITIONS; ALL WELLS PUMPING - DRY SEASON

TABLE A8-14

19-Jun-97
NONCARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | RAFd | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|---|
| Manganese | 0.0336 | 2 | 6.6E-04 | 0.001 | NA | 0.0E+00 | 0.047 | 1.4E-02 | 0.0E+00 | 1.4E-02 |
| Chloride | 80.5 | ND | | | NA | 0.0E+00 | ND | | 0.0E+00 | |
| Sulfate as SO4 | 109 | 0.73 | 7.8E-01 | 0.001 | NA | 0.0E+00 | 14 | 5.6E-02 | 0.0E+00 | 5.6E-02 |
| Sodium | 41.4 | ND | | | NA | 0.0E+00 | ND | | 0.0E+00 | |
| | | | | | | | SUMMARY HAZARD INDEX | 0.1 | 0 | 0.1 |

NA = Not applicable
Dermal exposures have not been calculated for inorganics per MADEP, 1995 "Guidance for Disposal Site Risk Characterization".

GWWKFBWW
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
ADULT FULL-TIME WORKER
FUTURE CONDITIONS; BUTTERS ROW #1 PUMPING - WET SEASON

TABLE A8-15

18-Jun-97

EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| Concentration in Ground Water | OHMgw | | mg/liter | Site-specific |
| Lifetime Average Daily Dose | LADD | calculated below | | MADEP, 1995 |
| Average Daily Dose | ADD | calculated below | | MADEP, 1995 |
| Ingestion Rate | IR | 1 | liters/day | Assumption, [1] |
| Surface Area Exposed | SA | | $cm^2$ | [2] |
| Body Weight | BW | 70 | kg | MADEP, 1995 |
| Conversion Factor | CF | 0.001 | $liter/cm^3$ | |
| Exposure Time | ET | | hours/day | [2] |
| Exposure Frequency | EF | 250 | days/year | Site-specific |
| Exposure Period | EP | 25 | years | Site-specific |
| Averaging Time | | | | |
| Cancer | ATc | 75 | years | MADEP, 1995 |
| Noncancer | ATn | 25 | years | MADEP, 1995 |
| Relative Absorption Factor (RAF) | | | | |
| Oral | RAFo | listed below | unitless | MADEP, 1995 |
| Dermal | RAFd | listed below | unitless | MADEP, 1995 |
| Permeability Constant | Kp | listed below | cm/hour | MADEP, 1995 |

MADEP, 1995 "Guidance for Disposal Site Risk Characterization"
[1] Assumes one-half the daily fluid intake is obtained from tap water at the workplace
[2] Worker does not shower and, therefore, dermal exposures are not evaluated

EQUATIONS

CANCER RISK = LADD (mg/kg-day) x CANCER SLOPE FACTOR $(mg/kg\text{-}day)^{-1}$

HAZARD QUOTIENT = ADD (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{LADD-INGESTION} = \frac{OHMgw \times IR \times RAFi \times EF \times EP}{BW \times ATc \times 365\ days/yr}$$

$$\text{ADD-INGESTION} = \frac{OHMgw \times IR \times RAFi \times EF \times EP}{BW \times ATn \times 365\ days/yr}$$

$$\text{LADD-DERMAL} = \frac{OHMgw \times SA \times Kp \times RAFd \times CF \times ED \times EF \times EP}{BW \times ATc \times 365\ days/yr}$$

$$\text{ADD-DERMAL} = \frac{OHMgw \times SA \times Kp \times RAFd \times CF \times ED \times EF \times EP}{BW \times ATn \times 365\ days/yr}$$

Note:
For noncarcinogenic risk, AT = EP

GWWKFBWW
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
ADULT FULL-TIME WORKER
FUTURE CONDITIONS; BUTTERS ROW #1 PUMPING - WET SEASON

TABLE A8-15

18-Jun-97
CARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | RAFd | INTAKE DERMAL (mg/kg-day) | CANCER SLOPE FACTOR (mg/kg-day)^-1 | CANCER RISK INGESTION | CANCER RISK DERMAL | TOTAL CANCER RISK |
|---|---|---|---|---|---|---|---|---|---|---|
| No potentially carcinogenic OHM of concern were detected. | | | | | | | | | | |
| | | | | | | SUMMARY CANCER RISK | | 0E+00 | 0E+00 | 0E+00 |

ABB Environmental Services, Inc.
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GWWKFBWW
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
ADULT FULL-TIME WORKER
FUTURE CONDITIONS; BUTTERS ROW #1 PUMPING - WET SEASON

TABLE A8-15

19-Jun-97
NONCARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | RAFd | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|---|
| Manganese | 0.0336 | 2 | 6.6E-04 | 0.001 | NA | 0.0E+00 | 0.047 | 1.4E-02 | 0.0E+00 | 1.4E-02 |
| Chloride | 90 | ND | | | NA | 0.0E+00 | ND | | 0.0E+00 | |
| Sulfate as SO4 | 113 | 0.73 | 8.1E-01 | 0.001 | NA | 0.0E+00 | 14 | 5.8E-02 | 0.0E+00 | 5.8E-02 |
| Sodium | 46 | ND | | | NA | 0.0E+00 | | | 0.0E+00 | |
| | | | | | | | SUMMARY HAZARD INDEX | 0.07 | 0 | 0.07 |

NA = Not applicable
Dermal exposures have not been calculated for inorganics per MADEP, 1995 "Guidance for Disposal Site Risk Characterization".

GWWKFBWD
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
ADULT FULL-TIME WORKER
FUTURE CONDITIONS; BUTTERS ROW #1 PUMPING - DRY SEASON

TABLE A8-16

18-Jun-97

EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| Concentration in Ground Water | OHMgw | | mg/liter | Site-specific |
| Lifetime Average Daily Dose | LADD | calculated below | | MADEP, 1995 |
| Average Daily Dose | ADD | calculated below | | MADEP, 1995 |
| Ingestion Rate | IR | 1 | liters/day | Assumption, [1] |
| Surface Area Exposed | SA | | $cm^2$ | [2] |
| Body Weight | BW | 70 | kg | MADEP, 1995 |
| Conversion Factor | CF | 0.001 | liter/$cm^3$ | |
| Exposure Time | ET | | hours/day | [2] |
| Exposure Frequency | EF | 250 | days/year | Site-specific |
| Exposure Period | EP | 25 | years | Site-specific |
| Averaging Time | | | | |
| Cancer | ATc | 75 | years | MADEP, 1995 |
| Noncancer | ATn | 25 | years | MADEP, 1995 |
| Relative Absorption Factor (RAF) | | | | |
| Oral | RAFo | listed below | unitless | MADEP, 1995 |
| Dermal | RAFd | listed below | unitless | MADEP, 1995 |
| Permeability Constant | Kp | listed below | cm/hour | MADEP, 1995 |

MADEP, 1995 "Guidance for Disposal Site Risk Characterization"
[1] Assumes one-half the daily fluid intake is obtained from tap water at the workplace
[2] Worker does not shower and, therefore, dermal exposures are not evaluated

EQUATIONS

CANCER RISK = LADD (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)^-1

HAZARD QUOTIENT = ADD (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{LADD-INGESTION} = \frac{\text{OHMgw x IR x RAFl x EF x EP}}{\text{BW x ATc x 365 days/yr}}$$

$$\text{ADD-INGESTION} = \frac{\text{OHMgw x IR x RAFl x EF x EP}}{\text{BW x ATn x 365 days/yr}}$$

$$\text{LADD-DERMAL} = \frac{\text{OHMgw x SA x Kp x RAFd x CF x ED x EF x EP}}{\text{BW x ATc x 365 days/yr}}$$

$$\text{ADD-DERMAL} = \frac{\text{OHMgw x SA x Kp x RAFd x CF x ED x EF x EP}}{\text{BW x ATn x 365 days/yr}}$$

Note:
For noncarcinogenic risk, AT = EP

GWWKFBWD
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
ADULT FULL-TIME WORKER
FUTURE CONDITIONS; BUTTERS ROW #1 PUMPING - DRY SEASON

TABLE A8-16

18-Jun-97
CARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | RAFd | INTAKE DERMAL (mg/kg-day) | CANCER SLOPE FACTOR (mg/kg-day)^-1 | CANCER RISK INGESTION | CANCER RISK DERMAL | TOTAL CANCER RISK |
|---|---|---|---|---|---|---|---|---|---|---|
| No potentially carcinogenic OHM of concern were detected. | | | | | | | | | | |
| | | | | | | SUMMARY CANCER RISK | | 0E+00 | 0E+00 | 0E+00 |

ABB Environmental Services, Inc.
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GWWKFBWD
INGESTION OF GROUND WATER - POST TREATMENT BUTTERS ROW TREATMENT PLANT
ADULT FULL-TIME WORKER
FUTURE CONDITIONS; BUTTERS ROW #1 PUMPING - DRY SEASON

TABLE A8-16

19-Jun-97
NONCARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | RAFd | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|---|
| Manganese | 0.0336 | 2 | 6.6E-04 | 0.001 | NA | 0.0E+00 | 0.047 | 1.4E-02 | 0.0E+00 | 1.4E-02 |
| Chloride | 79 | ND | | | NA | 0.0E+00 | ND | | 0.0E+00 | |
| Sulfate as SO4 | 82 | 0.73 | 5.9E-01 | 0.001 | NA | 0.0E+00 | 14 | 4.2E-02 | 0.0E+00 | 4.2E-02 |
| Sodium | 40 | ND | | | NA | 0.0E+00 | | | 0.0E+00 | |
| | | | | | | | SUMMARY HAZARD INDEX | 0.06 | 0 | 0.06 |

NA = Not applicable
Dermal exposures have not been calculated for inorganics per MADEP, 1995 "Guidance for Disposal Site Risk Characterization".

ATTACHMENT 9

# ATTACHMENT 9

# SURFACE WATER RISK CALCULATION SPREADSHEETS

MWSWH
INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER - ON-SITE DITCH
RECEPTOR: ON-SITE WORKER (PLANT B AREA AND MAINTENANCE) - CURRENT LAND USE; HISTORICAL DATA
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A9-1
*EXPOSURE PARAMETERS*

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| Concentration in Surface Water | OHMsw | hemical-specific | mg/liter | |
| Lifetime Average Daily Dose | LADD | alculated below | | MADEP, 1995 |
| Average Daily Dose | ADD | alculated below | | MADEP, 1995 |
| Ingestion Rate (1) | IR | 0.005 | liters/hour | Assumption |
| Surface Area Exposed (2) | SA | 3,900 | $cm^2$ | MADEP, 1995 |
| Body Weight (2) | BW | 70 | kg | USEPA, 1989 |
| Conversion Factor | CF | 0.001 | liter/$cm^3$ | |
| Exposure Time (3) | ET | 4 | hours/event | Assumption |
| Exposure Frequency (3) | EF | 3 | event/year | Assumption |
| Exposure Period | EP | 25 | years | USEPA, 1991 |
| Averaging Time | | | | |
| Cancer | ATc | 75 | years | MADEP, 1995 |
| Noncancer | ATn | 25 | years | USEPA, 1991 |
| Relative Absorption Factor (RAF) | | | | |
| Oral | RAFo | listed below | unitless | MADEP, 1995 |
| Dermal | RAFd | listed below | unitless | MADEP, 1995 |
| Permeability Constant | Kp | listed below | cm/hour | MADEP, 1995 |

(1) Assumption: 1/10 the amount for swimming.
(2) 50th percentile of surface areas for males: hands, arms.
(3) 3 events per year, 4 hours per event. These data are based on an interview with facility personnel (9/24/96).

USEPA, 1989. Exposure Factors Handbook.EPA/600/8-89/043. May 1989.
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors." OSWER Directive 9285.6-03.
MADEP, 1995. "Guidance for Disposal Site Risk Characterization."

EQUATIONS

CANCER RISK = LADD (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)^-1)

HAZARD QUOTIENT = ADD (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{LADD-INGESTION} = \frac{OHMsw \times IR \times RAFi \times EF \times EP \times ET}{BW \times ATc \times 365\ days/yr}$$

$$\text{ADD-INGESTION} = \frac{OHMsw \times IR \times RAFi \times EF \times EP \times ET}{BW \times ATn \times 365\ days/yr}$$

$$\text{LADD-DERMAL} = \frac{OHMsw \times SA \times Kp \times RAFd \times CF \times ET \times EF \times EP}{BW \times ATc \times 365\ days/yr}$$

$$\text{ADD-DERMAL} = \frac{OHMsw \times SA \times Kp \times RAFd \times CF \times ET \times EF \times EP}{BW \times ATn \times 365\ days/yr}$$

Note:

For noncarcinogenic risk, AT = EP

MWSWH
INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER - ON-SITE DITCH
RECEPTOR: ON-SITE WORKER (PLANT B AREA AND MAINTENANCE) - CURRENT LAND USE; HISTORICAL DATA
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A9-1
CARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | DERMAL RAF | INTAKE DERMAL (mg/kg-day) | CANCER SLOPE FACTOR (mg/kg-day)^-1 | CANCER RISK INGESTION | CANCER RISK DERMAL | TOTAL CANCER RISK |
|---|---|---|---|---|---|---|---|---|---|---|
| Bromoform | 0.0023 | 1.00 | 1.8E-09 | 2.6E-03 | 1.00 | 3.7E-09 | 7.9E-03 | 1.4E-11 | 2.9E-11 | 4.3E-11 |
| N-Nitrosodiphenylamine | 0.003 | 0.92 | 2.2E-09 | 1.9E-02 | 1.00 | 3.4E-08 | 4.9E-03 | 1.1E-11 | 1.7E-10 | 1.8E-10 |
| bis(2-EthylHexyl)phthalate | 0.009 | 1.00 | 7.0E-09 | 5.3E-03 | 1.05 | 3.1E-08 | 1.4E-02 | 9.9E-11 | 4.3E-10 | 5.3E-10 |
| Arsenic | 0.0241 | 1.00 | 1.9E-08 | 1.0E-03 | 1.82 | 2.7E-08 | 1.5E+00 | 2.8E-08 | 4.0E-08 | 6.8E-08 |
| Lead | 0.0173 | | | 1.0E-03 | | 0.0E+00 | ND | | | |
| | | | | | | SUMMARY CANCER RISK | | 3E-08 | 4E-08 | 7E-08 |

MWSWH
INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER - ON-SITE DITCH
RECEPTOR: ON-SITE WORKER (PLANT B AREA AND MAINTENANCE) - CURRENT LAND USE; HISTORICAL DATA
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A9-1
NONCARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | DERMAL RAF | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|---|
| 2,4,4-Trimethyl-1-pentene | 0.0082 | 0.99 | 1.9E-08 | 2.3E-01 | 1.00 | 3.5E-06 | 2.1E-01 | 9.3E-08 | 1.7E-05 | 1.7E-05 |
| 2,4,4-Trimethyl-2-Pentene | 0.0048 | 0.99 | 1.1E-08 | 2.3E-01 | 1.00 | 2.0E-06 | 2.1E-01 | 5.4E-08 | 1.0E-05 | 1.0E-05 |
| Bromoform | 0.0023 | 1.00 | 5.4E-09 | 2.6E-03 | 1.00 | 1.1E-08 | 2.0E-02 | 2.7E-07 | 5.5E-07 | 8.2E-07 |
| Di-n-octylphthalate | 0.0048 | 0.97 | 1.1E-08 | 2.9E+01 | 1.05 | 2.6E-04 | 2.0E-02 | 5.5E-07 | 1.3E-02 | 1.3E-02 |
| N-Nitrosodiphenylamine | 0.003 | 0.97 | 6.8E-09 | 1.9E-02 | 1.05 | 1.1E-07 | 5.0E-02 | 1.4E-07 | 2.2E-06 | 2.3E-06 |
| Phenol | 0.002 | 1.00 | 4.7E-09 | 8.2E-03 | 1.10 | 3.3E-08 | 6.0E-01 | 7.8E-09 | 5.5E-08 | 6.3E-08 |
| bis(2-EthylHexyl)phthalate | 0.009 | 1.00 | 2.1E-08 | 5.3E-03 | 1.05 | 9.2E-08 | 2.0E-02 | 1.1E-06 | 4.6E-06 | 5.7E-06 |
| Aluminum | 5.615 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Arsenic | 0.0241 | 1.00 | 5.7E-08 | 1.0E-03 | 1.82 | 8.0E-08 | 3.0E-04 | 1.9E-04 | 2.7E-04 | 4.6E-04 |
| Barium | 0.0236 | 0.73 | 4.0E-08 | 1.0E-03 | 1.82 | 7.9E-08 | 7.0E-02 | 5.8E-07 | 1.1E-06 | 1.7E-06 |
| Calcium | 39.075 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Chromium | 0.4062 | 1.00 | 9.5E-07 | 1.0E-03 | 5.76 | 4.3E-06 | 1.0E+00 | 9.5E-07 | 4.3E-06 | 5.2E-06 |
| Cobalt | 0.0132 | 1.90 | 5.9E-08 | 1.0E-03 | 5.76 | 1.4E-07 | 1.8E-01 | 3.3E-07 | 7.7E-07 | 1.1E-06 |
| Hexavalent Chromium | 0.0408 | 1.00 | 9.6E-08 | 1.0E-03 | 1.82 | 1.4E-07 | 5.0E-03 | 1.9E-05 | 2.7E-05 | 4.6E-05 |
| Iron | 7.89 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Lead | 0.0173 | 0.50 | 2.0E-08 | 1.0E-03 | 3.00 | 9.5E-08 | 7.5E-04 | 2.7E-05 | 1.3E-04 | 1.5E-04 |
| Magnesium | 4.75 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Manganese | 0.7925 | 1.90 | 3.5E-06 | 1.0E-03 | 5.76 | 8.4E-06 | 4.7E-02 | 7.5E-05 | 1.8E-04 | 2.5E-04 |
| Mercury | 0.0002 | 1.00 | 4.7E-10 | 1.0E-03 | 5.76 | 2.1E-09 | 3.0E-04 | 1.6E-06 | 7.0E-06 | 8.6E-06 |
| Nickel | 0.0224 | 1.00 | 5.3E-08 | 1.0E-03 | 5.76 | 2.4E-07 | 2.0E-02 | 2.6E-06 | 1.2E-05 | 1.4E-05 |
| Potassium | 2.0558 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Sodium | 122.75 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Vanadium | 0.0273 | 0.73 | 4.7E-08 | 1.0E-03 | 1.82 | 9.1E-08 | 7.0E-03 | 6.7E-06 | 1.3E-05 | 2.0E-05 |
| Zinc | 0.0611 | 1.00 | 1.4E-07 | 1.0E-03 | 5.76 | 6.4E-07 | 3.0E-01 | 4.8E-07 | 2.1E-06 | 2.6E-06 |
| Chloride | 128.5833 | | | 1.0E-03 | | 0.0E+00 | | | | |

MWSWH
INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER - ON-SITE DITCH
RECEPTOR: ON-SITE WORKER (PLANT B AREA AND MAINTENANCE) - CURRENT LAND USE; HISTORICAL DATA
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A9-1
NONCARCINOGENIC EFFECTS (continued)

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | DERMAL RAF | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|---|
| Nitrate as N | 6.5 | 0.73 | 1.1E-05 | 1.0E-03 | 1.82 | 2.2E-05 | 1.6E+00 | 6.9E-06 | 1.4E-05 | 2.0E-05 |
| Nitrite as N | 0.0695 | 0.73 | 1.2E-07 | 1.0E-03 | 1.82 | 2.3E-07 | 1.0E-01 | 1.2E-06 | 2.3E-06 | 3.5E-06 |
| Nitrogen, Ammonia | 28.4458 | 0.73 | 4.9E-05 | 1.0E-03 | 1.82 | 9.5E-05 | 3.7E-01 | 1.3E-04 | 2.6E-04 | 3.9E-04 |
| Sulfate as SO4 | 304.5 | | | 1.0E-03 | | 0.0E+00 | | | | |
| | | | | | | SUMMARY HAZARD INDEX | | 6E-04 | 1E-02 | 1E-02 |

TRSWEDH
INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER - EAST DITCH
RECEPTOR: NEIGHBORHOOD RESIDENT WADING (AGES 7 THROUGH 16) - CURRENT LAND USE; HISTORICAL DATA
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A9-2
EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| Concentration in Surface Water | OHMsw | hemical-specific | mg/liter | |
| Lifetime Average Daily Dose | LADD | alculated below | | MADEP, 1995 |
| Average Daily Dose | ADD | alculated below | | MADEP, 1995 |
| Ingestion Rate (1) | IR | 0.005 | liters/hour | Assumption |
| Surface Area Exposed (2) | SA | 6,578 | $cm^2$ | MADEP, 1995 |
| Body Weight (2) | BW | 42 | kg | MADEP, 1995 |
| Conversion Factor | CF | 0.001 | $liter/cm^3$ | |
| Exposure Time (3) | ET | 2 | hours/event | Assumption |
| Exposure Frequency (3) | EF | 6 | event/year | Assumption |
| Exposure Period | EP | 10 | years | Assumption |
| Averaging Time | | | | |
| Cancer | ATc | 75 | years | MADEP, 1995 |
| Noncancer | ATn | 10 | years | Assumption |
| Relative Absorption Factor (RAF) | | | | |
| Oral | RAFo | listed below | unitless | MADEP, 1995 |
| Dermal | RAFd | listed below | unitless | MADEP, 1995 |
| Permeability Constant | Kp | listed below | cm/hour | MADEP, 1995 |

(1) Assumption: 1/10 the amount for swimming.
(2) 50th percentile of surface areas/body weights for males aged 7 through 16: hands, forearms, legs, feet.
(3) 2 events per month June through August, 2 hours per event.
MADEP, 1995. "Guidance for Disposal Site Risk Characterization."

EQUATIONS

CANCER RISK = LADD (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)^-1

HAZARD QUOTIENT = ADD (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{LADD-INGESTION} = \frac{OHMsw \times IR \times RAFi \times EF \times EP \times ET}{BW \times ATc \times 365 \text{ days/yr}}$$

$$\text{ADD-INGESTION} = \frac{OHMsw \times IR \times RAFi \times EF \times EP \times ET}{BW \times ATn \times 365 \text{ days/yr}}$$

$$\text{LADD-DERMAL} = \frac{OHMsw \times SA \times Kp \times RAFd \times CF \times ET \times EF \times EP}{BW \times ATc \times 365 \text{ days/yr}}$$

$$\text{ADD-DERMAL} = \frac{OHMsw \times SA \times Kp \times RAFd \times CF \times ET \times EF \times EP}{BW \times ATn \times 365 \text{ days/yr}}$$

Note:

For noncarcinogenic risk, AT = EP

TRSWEDH
INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER - EAST DITCH
RECEPTOR: NEIGHBORHOOD RESIDENT WADING (AGES 7 THROUGH 16) - CURRENT LAND USE; HISTORICAL DATA
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A9-2
CARCINOGENIC EFFECTS

| CHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | DERMAL RAF | INTAKE DERMAL (mg/kg-day) | CANCER SLOPE FACTOR (mg/kg-day)^-1 | CANCER RISK INGESTION | CANCER RISK DERMAL | TOTAL CANCER RISK |
|---|---|---|---|---|---|---|---|---|---|---|
| Methylene Chloride | 0.003 | 1.00 | 1.6E-09 | 4.5E-03 | 1.00 | 9.3E-09 | 7.5E-03 | 1.2E-11 | 7.0E-11 | 8.1E-11 |
| Trichloroethene (TCE) | 0.005 | 1.00 | 2.6E-09 | 2.3E-01 | 1.00 | 7.9E-07 | 1.5E-02 | 3.9E-11 | 1.2E-08 | 1.2E-08 |
| Vinyl Chloride | 0.002 | 1.53 | 1.6E-09 | 7.3E-03 | 1.02 | 1.0E-08 | 1.9E+00 | 3.0E-09 | 1.9E-08 | 2.2E-08 |
| N-Nitrosodiphenylamine | 0.0025 | 0.92 | 1.2E-09 | 1.9E-02 | 1.00 | 3.2E-08 | 4.9E-03 | 5.9E-12 | 1.6E-10 | 1.6E-10 |
| bis(2-EthylHexyl)phthalate | 0.0122 | 1.00 | 6.4E-09 | 5.3E-03 | 1.05 | 4.7E-08 | 1.4E-02 | 8.9E-11 | 6.6E-10 | 7.4E-10 |
| Arsenic | 0.0088 | 1.00 | 4.6E-09 | 1.0E-03 | 1.82 | 1.1E-08 | 1.5E+00 | 6.9E-09 | 1.6E-08 | 2.3E-08 |
| Lead | 0.007 | | | 1.0E-03 | | 0.0E+00 | ND | | | |
| | | | | | | SUMMARY CANCER RISK | | 1E-08 | 5E-08 | 6E-08 |

TRSWEDH
INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER - EAST DITCH
RECEPTOR: NEIGHBORHOOD RESIDENT WADING (AGES 7 THROUGH 16) - CURRENT LAND USE; HISTORICAL DATA
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A9-2
NONCARCINOGENIC EFFECTS

| CHEM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | DERMAL RAF | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|---|
| 1,1,1-Trichloroethane | 0.0027 | 1.00 | 1.1E-08 | 1.7E-02 | 1.00 | 2.4E-07 | 9.0E-01 | 1.2E-08 | 2.6E-07 | 2.7E-07 |
| 1,2-Dichloroethene(total) | 0.0036 | 1.00 | 1.4E-08 | 1.0E-02 | 1.00 | 1.9E-07 | 9.0E-03 | 1.6E-06 | 2.1E-05 | 2.2E-05 |
| 2,4,4-Trimethyl-1-pentene | 0.007 | 0.99 | 2.7E-08 | 2.3E-01 | 1.00 | 8.4E-06 | 2.1E-01 | 1.3E-07 | 4.1E-05 | 4.1E-05 |
| 2,4,4-Trimethyl-2-Pentene | 0.0038 | 0.99 | 1.5E-08 | 2.3E-01 | 1.00 | 4.5E-06 | 2.1E-01 | 7.2E-08 | 2.2E-05 | 2.2E-05 |
| 4-Methyl-2-Pentanone (MIBK) | 0.002 | 1.00 | 7.8E-09 | 3.4E-03 | 1.00 | 3.5E-08 | 8.0E-02 | 9.8E-08 | 4.4E-07 | 5.4E-07 |
| Chloroethane | 0.0048 | 1.00 | 1.9E-08 | 8.0E-03 | 1.00 | 2.0E-07 | 4.0E-03 | 4.7E-06 | 4.9E-05 | 5.4E-05 |
| Ethylbenzene | 0.0023 | 1.00 | 9.0E-09 | 1.0E+00 | 1.00 | 1.2E-05 | 1.0E-01 | 9.0E-08 | 1.2E-04 | 1.2E-04 |
| Methylene Chloride | 0.003 | 1.00 | 1.2E-08 | 4.5E-03 | 1.00 | 7.0E-08 | 6.0E-02 | 2.0E-07 | 1.2E-06 | 1.4E-06 |
| Toluene | 0.0263 | 1.00 | 1.0E-07 | 1.0E+00 | 1.00 | 1.4E-04 | 2.0E-01 | 5.1E-07 | 6.8E-04 | 6.8E-04 |
| Trichloroethene (TCE) | 0.005 | 1.00 | 2.0E-08 | 2.3E-01 | 1.10 | 6.5E-06 | 2.0E-03 | 9.8E-06 | 3.3E-03 | 3.3E-03 |
| Vinyl Chloride | 0.002 | 1.00 | 7.8E-09 | 7.3E-03 | 1.02 | 7.7E-08 | 1.0E-03 | 7.8E-06 | 7.7E-05 | 8.5E-05 |
| Xylenes, Total | 0.0034 | 1.00 | 1.3E-08 | 8.0E-02 | 1.00 | 1.4E-06 | 2.0E+00 | 6.7E-09 | 7.0E-07 | 7.1E-07 |
| Di-n-octylphthalate | 0.0053 | 0.97 | 2.0E-08 | 2.9E+01 | 1.05 | 8.2E-04 | 2.0E-02 | 1.0E-06 | 4.1E-02 | 4.1E-02 |
| N-Nitrosodiphenylamine | 0.0025 | 0.97 | 9.5E-09 | 1.9E-02 | 1.05 | 2.5E-07 | 5.0E-02 | 1.9E-07 | 5.1E-06 | 5.3E-06 |
| Phenol | 0.001 | 1.00 | 3.9E-09 | 8.2E-03 | 1.10 | 4.6E-08 | 6.0E-01 | 6.5E-09 | 7.7E-08 | 8.4E-08 |
| bis(2-EthylHexyl)phthalate | 0.0122 | 1.00 | 4.8E-08 | 5.3E-03 | 1.05 | 3.5E-07 | 2.0E-02 | 2.4E-06 | 1.8E-05 | 2.0E-05 |
| Aluminum | 1.4342 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Arsenic | 0.0088 | 1.00 | 3.4E-08 | 1.0E-03 | 1.82 | 8.2E-08 | 3.0E-04 | 1.1E-04 | 2.7E-04 | 3.9E-04 |
| Barium | 0.0239 | 0.73 | 6.8E-08 | 1.0E-03 | 1.82 | 2.2E-07 | 7.0E-02 | 9.7E-07 | 3.2E-06 | 4.2E-06 |
| Calcium | 29.5833 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Chromium | 0.1598 | 1.00 | 6.3E-07 | 1.0E-03 | 5.76 | 4.7E-06 | 1.0E+00 | 6.3E-07 | 4.7E-06 | 5.4E-06 |
| Hexavalent Chromium | 0.0131 | 1.00 | 5.1E-08 | 1.0E-03 | 1.82 | 1.2E-07 | 5.0E-03 | 1.0E-05 | 2.5E-05 | 3.5E-05 |
| Iron | 2.23 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Lead | 0.007 | 0.50 | 1.4E-08 | 1.0E-03 | 3.00 | 1.1E-07 | 7.5E-04 | 1.8E-05 | 1.4E-04 | 1.6E-04 |
| Magnesium | 5.0833 | | | 1.0E-03 | | 0.0E+00 | | | | |

TRSWEDH
INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER - EAST DITCH
RECEPTOR: NEIGHBORHOOD RESIDENT WADING (AGES 7 THROUGH 16) - CURRENT LAND USE; HISTORICAL DATA
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A9-2
NONCARCINOGENIC EFFECTS (continued)

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | DERMAL RAF | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|---|
| Manganese | 0.6908 | 1.90 | 5.1E-06 | 1.0E-03 | 5.76 | 2.0E-05 | 4.7E-02 | 1.1E-04 | 4.4E-04 | 5.5E-04 |
| Potassium | 3.575 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Sodium | 64.75 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Zinc | 0.0777 | 1.00 | 3.0E-07 | 1.0E-03 | 5.76 | 2.3E-06 | 3.0E-01 | 1.0E-06 | 7.7E-06 | 8.7E-06 |
| Chloride | 86 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Nitrate as N | 4.075 | 0.73 | 1.2E-05 | 1.0E-03 | 1.82 | 3.8E-05 | 1.6E+00 | 7.2E-06 | 2.4E-05 | 3.1E-05 |
| Nitrite as N | 0.0687 | 0.73 | 2.0E-07 | 1.0E-03 | 1.82 | 6.4E-07 | 1.0E-01 | 2.0E-06 | 6.4E-06 | 8.4E-06 |
| Nitrogen, Ammonia | 16.455 | 0.73 | 4.7E-05 | 1.0E-03 | 1.82 | 1.5E-04 | 3.7E-01 | 1.3E-04 | 4.2E-04 | 5.4E-04 |
| Sulfate as SO4 | 120.1667 | | | 1.0E-03 | | 0.0E+00 | | | | |
| | | | | | | SUMMARY HAZARD INDEX | | 4E-04 | 6E-02 | 6E-02 |

TRSWWDH
INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER - WEST DITCH
RECEPTOR: NEIGHBORHOOD RESIDENT WADING (AGES 7 THROUGH 16) - CURRENT LAND USE; HISTORICAL DATA
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A9-3
EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| Concentration in Surface Water | OHMsw | hemical-specific | mg/liter | |
| Lifetime Average Daily Dose | LADD | alculated below | | MADEP, 1995 |
| Average Daily Dose | ADD | alculated below | | MADEP, 1995 |
| Ingestion Rate (1) | IR | 0.005 | liters/hour | Assumption |
| Surface Area Exposed (2) | SA | 6,578 | $cm^2$ | MADEP, 1995 |
| Body Weight (2) | BW | 42 | kg | MADEP, 1995 |
| Conversion Factor | CF | 0.001 | $liter/cm^3$ | |
| Exposure Time (3) | ET | 2 | hours/event | Assumption |
| Exposure Frequency (3) | EF | 6 | event/year | Assumption |
| Exposure Period | EP | 10 | years | Assumption |
| Averaging Time | | | | |
| Cancer | ATc | 75 | years | MADEP, 1995 |
| Noncancer | ATn | 10 | years | Assumption |
| Relative Absorption Factor (RAF) | | | | |
| Oral | RAFo | listed below | unitless | MADEP, 1995 |
| Dermal | RAFd | listed below | unitless | MADEP, 1995 |
| Permeability Constant | Kp | listed below | cm/hour | MADEP, 1995 |

(1) Assumption: 1/10 the amount for swimming.
(2) 50th percentile of surface areas/body weights for males aged 7 through 16: hands, forearms, legs, feet.
(3) 2 events per month June through August, 2 hours per event.
MADEP, 1995. "Guidance for Disposal Site Risk Characterization."

EQUATIONS

CANCER RISK = LADD (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)^-1)

HAZARD QUOTIENT = ADD (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{LADD-INGESTION} = \frac{OHMsw \times IR \times RAFI \times EF \times EP \times ET}{BW \times ATc \times 365\ days/yr}$$

$$\text{ADD-INGESTION} = \frac{OHMsw \times IR \times RAFI \times EF \times EP \times ET}{BW \times ATn \times 365\ days/yr}$$

$$\text{LADD-DERMAL} = \frac{OHMsw \times SA \times Kp \times RAFd \times CF \times ET \times EF \times EP}{BW \times ATc \times 365\ days/yr}$$

$$\text{ADD-DERMAL} = \frac{OHMsw \times SA \times Kp \times RAFd \times CF \times ET \times EF \times EP}{BW \times ATn \times 365\ days/yr}$$

Note:

For noncarcinogenic risk, AT = EP

TRSWWDH
INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER - WEST DITCH
RECEPTOR: NEIGHBORHOOD RESIDENT WADING (AGES 7 THROUGH 16) - CURRENT LAND USE; HISTORICAL DATA
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A9-3
CARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | DERMAL RAF | INTAKE DERMAL (mg/kg-day) | CANCER SLOPE FACTOR (mg/kg-day)^-1 | CANCER RISK INGESTION | CANCER RISK DERMAL | TOTAL CANCER RISK |
|---|---|---|---|---|---|---|---|---|---|---|
| Bromoform | 0.0021 | 1.00 | 1.1E-09 | 2.6E-03 | 1.00 | 3.7E-09 | 7.9E-03 | 8.7E-12 | 3.0E-11 | 3.8E-11 |
| N-Nitrosodiphenylamine | 0.0111 | 0.92 | 5.3E-09 | 1.9E-02 | 1.00 | 1.4E-07 | 4.9E-03 | 2.6E-11 | 7.0E-10 | 7.3E-10 |
| bis(2-EthylHexyl)phthalate | 0.006 | 1.00 | 3.1E-09 | 5.3E-03 | 1.05 | 2.3E-08 | 1.4E-02 | 4.4E-11 | 3.2E-10 | 3.7E-10 |
| Lead | 0.0056 | | | 1.0E-03 | | 0.0E+00 | ND | | | |
| | | | | | | SUMMARY CANCER RISK | | 8E-11 | 1E-09 | 1E-09 |

TRSWWDH
INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER - WEST DITCH
RECEPTOR: NEIGHBORHOOD RESIDENT WADING (AGES 7 THROUGH 16) - CURRENT LAND USE; HISTORICAL DATA
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A9-3
NONCARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | DERMAL RAF | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|---|
| 2,4,4-Trimethyl-1-pentene | 0.0539 | 0.99 | 2.1E-07 | 2.3E-01 | 1.00 | 6.4E-05 | 2.1E-01 | 1.0E-06 | 3.1E-04 | 3.2E-04 |
| 2,4,4-Trimethyl-2-Pentene | 0.0236 | 0.99 | 9.1E-08 | 2.3E-01 | 1.00 | 2.8E-05 | 2.1E-01 | 4.5E-07 | 1.4E-04 | 1.4E-04 |
| 2-Butanone (MEK) | 0.0088 | 1.00 | 3.4E-08 | 5.0E-03 | 1.00 | 2.3E-07 | 6.0E-01 | 5.7E-08 | 3.8E-07 | 4.4E-07 |
| Acetone | 0.0182 | 1.00 | 7.1E-08 | 5.7E-04 | 1.00 | 5.3E-08 | 1.0E-01 | 7.1E-07 | 5.3E-07 | 1.2E-06 |
| Bromoform | 0.0021 | 1.00 | 8.2E-09 | 2.6E-03 | 1.00 | 2.8E-08 | 2.0E-02 | 4.1E-07 | 1.4E-06 | 1.8E-06 |
| Di-n-octylphthalate | 0.001 | 0.97 | 3.8E-09 | 2.9E+01 | 1.05 | 1.6E-04 | 2.0E-02 | 1.9E-07 | 7.8E-03 | 7.8E-03 |
| N-Nitrosodiphenylamine | 0.0111 | 0.97 | 4.2E-08 | 1.9E-02 | 1.05 | 1.1E-06 | 5.0E-02 | 8.4E-07 | 2.3E-05 | 2.3E-05 |
| Phenol | 0.003 | 1.00 | 1.2E-08 | 8.2E-03 | 1.10 | 1.4E-07 | 6.0E-01 | 2.0E-08 | 2.3E-07 | 2.5E-07 |
| bis(2-EthylHexyl)phthalate | 0.006 | 1.00 | 2.3E-08 | 5.3E-03 | 1.05 | 1.7E-07 | 2.0E-02 | 1.2E-06 | 8.6E-06 | 9.8E-06 |
| Aluminum | 11.73 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Barium | 0.027 | 0.73 | 7.7E-08 | 1.0E-03 | 1.82 | 2.5E-07 | 7.0E-02 | 1.1E-06 | 3.6E-06 | 4.7E-06 |
| Calcium | 27 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Chromium | 3.0224 | 1.00 | 1.2E-05 | 1.0E-03 | 5.76 | 9.0E-05 | 1.0E+00 | 1.2E-05 | 9.0E-05 | 1.0E-04 |
| Cobalt | 0.0342 | 1.90 | 2.5E-07 | 1.0E-03 | 5.76 | 1.0E-06 | 6.0E-02 | 4.2E-06 | 1.7E-05 | 2.1E-05 |
| Copper | 0.0394 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Hexavalent Chromium | 0.2 | 1.00 | 7.8E-07 | 1.0E-03 | 1.82 | 1.9E-06 | 5.0E-03 | 1.6E-04 | 3.7E-04 | 5.3E-04 |
| Iron | 8.4945 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Lead | 0.0056 | 0.50 | 1.1E-08 | 1.0E-03 | 3.00 | 8.7E-08 | 7.5E-04 | 1.5E-05 | 1.2E-04 | 1.3E-04 |
| Magnesium | 7.65 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Manganese | 1.545 | 1.90 | 1.2E-05 | 1.0E-03 | 5.76 | 4.6E-05 | 4.7E-02 | 2.5E-04 | 9.8E-04 | 1.2E-03 |
| Nickel | 0.0425 | 1.00 | 1.7E-07 | 1.0E-03 | 5.76 | 1.3E-06 | 2.0E-02 | 8.3E-06 | 6.3E-05 | 7.1E-05 |
| Potassium | 2.075 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Sodium | 118.75 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Zinc | 0.0764 | 1.00 | 3.0E-07 | 1.0E-03 | 5.76 | 2.3E-06 | 3.0E-01 | 1.0E-06 | 7.6E-06 | 8.6E-06 |
| Chloride | 114.75 | | | 1.0E-03 | | 0.0E+00 | | | | |

TRSWWDH
INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER - WEST DITCH
RECEPTOR: NEIGHBORHOOD RESIDENT WADING (AGES 7 THROUGH 16) - CURRENT LAND USE; HISTORICAL DATA
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A9-3
NONCARCINOGENIC EFFECTS (continued)

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | DERMAL RAF | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|---|
| Nitrate as N | 0.7 | 0.73 | 2.0E-06 | 1.0E-03 | 1.82 | 6.6E-06 | 1.6E+00 | 1.2E-06 | 4.1E-06 | 5.3E-06 |
| Nitrogen, Ammonia | 57.35 | 0.73 | 1.6E-04 | 1.0E-03 | 1.82 | 5.4E-04 | 3.7E-01 | 4.4E-04 | 1.5E-03 | 1.9E-03 |
| Sulfate as SO4 | 383.25 | | | 1.0E-03 | | 0.0E+00 | | | | |
| | | | | | | SUMMARY HAZARD INDEX | | 9E-04 | 1E-02 | 1E-02 |

MWSWR
INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER - ON-SITE DITCH
RECEPTOR: ON-SITE WORKER (PLANT B AREA AND MAINTENANCE) - CURRENT LAND USE; RECENT DATA
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A9-4
EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| **Concentration in Surface Water** | OHMsw | hemical-specific | mg/liter | |
| **Lifetime Average Daily Dose** | LADD | alculated below | | MADEP, 1995 |
| **Average Daily Dose** | ADD | alculated below | | MADEP, 1995 |
| **Ingestion Rate (1)** | IR | 0.005 | liters/hour | Assumption |
| **Surface Area Exposed (2)** | SA | 3,900 | $cm^2$ | MADEP, 1995 |
| **Body Weight (2)** | BW | 70 | kg | USEPA, 1989 |
| **Conversion Factor** | CF | 0.001 | $liter/cm^3$ | |
| **Exposure Time (3)** | ET | 4 | hours/event | Assumption |
| **Exposure Frequency (3)** | EF | 3 | event/year | Assumption |
| **Exposure Period** | EP | 25 | years | USEPA, 1991 |
| **Averaging Time** | | | | |
| **Cancer** | ATc | 75 | years | MADEP, 1995 |
| **Noncancer** | ATn | 25 | years | USEPA, 1991 |
| **Relative Absorption Factor (RAF)** | | | | |
| **Oral** | RAFo | listed below | unitless | MADEP, 1995 |
| **Dermal** | RAFd | listed below | unitless | MADEP, 1995 |
| **Permeability Constant** | Kp | listed below | cm/hour | MADEP, 1995 |

(1) Assumption: 1/10 the amount for swimming.
(2) 50th percentile of surface areas for males: hands, arms.
(3) 3 events per year, 4 hours per event. These data are based on an interview with facility personnel (9/24/96).


USEPA, 1989. Exposure Factors Handbook.EPA/600/8-89/043. May 1989.
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors." OSWER Directive 9285.6-03.
MADEP, 1995. "Guidance for Disposal Site Risk Characterization."


EQUATIONS

**CANCER RISK = LADD (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)^-1)**

**HAZARD QUOTIENT = ADD (mg/kg-day) / REFERENCE DOSE (mg/kg-day)**

**LADD-INGESTION =** $\dfrac{OHMsw \times IR \times RAFI \times EF \times EP \times ET}{BW \times ATc \times 365\ days/yr}$

**ADD-INGESTION =** $\dfrac{OHMsw \times IR \times RAFI \times EF \times EP \times ET}{BW \times ATn \times 365\ days/yr}$

**LADD-DERMAL =** $\dfrac{OHMsw \times SA \times Kp \times RAFd \times CF \times ET \times EF \times EP}{BW \times ATc \times 365\ days/yr}$

**ADD-DERMAL =** $\dfrac{OHMsw \times SA \times Kp \times RAFd \times CF \times ET \times EF \times EP}{BW \times ATn \times 365\ days/yr}$

**Note:**

**For noncarcinogenic risk, AT = EP**

MWSWR
INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER - ON-SITE DITCH
RECEPTOR: ON-SITE WORKER (PLANT B AREA AND MAINTENANCE) - CURRENT LAND USE; RECENT DATA
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A9-4

CARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | DERMAL RAF | INTAKE DERMAL (mg/kg-day) | CANCER SLOPE FACTOR (mg/kg-day)^-1 | CANCER RISK INGESTION | CANCER RISK DERMAL | TOTAL CANCER RISK |
|---|---|---|---|---|---|---|---|---|---|---|
| There are no potentially carcinogenic OHM of concern. | | | | | | | | | | |
| | | | | | | SUMMARY CANCER RISK | | 0E+00 | 0E+00 | 0E+00 |

MWSWR
INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER - ON-SITE DITCH
RECEPTOR: ON-SITE WORKER (PLANT B AREA AND MAINTENANCE) - CURRENT LAND USE; RECENT DATA
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A9-4
NONCARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | DERMAL RAF | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|---|
| Aluminum | 1.045 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Barium | 0.0273 | 0.73 | 4.7E-08 | 1.0E-03 | 1.82 | 9.1E-08 | 7.0E-02 | 6.7E-07 | 1.3E-06 | 2.0E-06 |
| Calcium | 154.375 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Chromium | 0.0136 | 1.00 | 3.2E-08 | 1.0E-03 | 5.76 | 1.4E-07 | 1.0E+00 | 3.2E-08 | 1.4E-07 | 1.8E-07 |
| Iron | 1.1868 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Magnesium | 4.45 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Manganese | 0.5063 | 1.90 | 2.3E-06 | 1.0E-03 | 5.76 | 5.3E-06 | 4.7E-02 | 4.8E-05 | 1.1E-04 | 1.6E-04 |
| Potassium | 2.625 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Sodium | 70.5 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Chloride | 76 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Nitrate & Nitrite as N | 6.8 | 0.73 | 1.2E-05 | 1.0E-03 | 1.82 | 2.3E-05 | 1.0E-01 | 1.2E-04 | 2.3E-04 | 3.4E-04 |
| Nitrate as N | 3.8833 | 0.73 | 6.6E-06 | 1.0E-03 | 1.82 | 1.3E-05 | 1.6E+00 | 4.1E-06 | 8.1E-06 | 1.2E-05 |
| Nitrogen, Ammonia | 51.6667 | 0.73 | 8.8E-05 | 1.0E-03 | 1.82 | 1.7E-04 | 3.7E-01 | 2.4E-04 | 4.7E-04 | 7.0E-04 |
| Sulfate as SO4 | 597.5 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Sulfide | 1.25 | | | 1.0E-03 | | 0.0E+00 | | | | |
| | | | | | | | SUMMARY HAZARD INDEX | 4E-04 | 8E-04 | 1E-03 |

TRSWEDR
INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER - EAST DITCH
RECEPTOR: NEIGHBORHOOD RESIDENT WADING (AGES 7 THROUGH 16) - CURRENT LAND USE; RECENT DATA
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A9-5
EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| **Concentration in Surface Water** | OHMsw | hemical-specific | mg/liter | |
| **Lifetime Average Daily Dose** | LADD | alculated below | | MADEP, 1995 |
| **Average Daily Dose** | ADD | alculated below | | MADEP, 1995 |
| **Ingestion Rate (1)** | IR | 0.005 | liters/hour | Assumption |
| **Surface Area Exposed (2)** | SA | 6,578 | cm² | MADEP, 1995 |
| **Body Weight (2)** | BW | 42 | kg | MADEP, 1995 |
| **Conversion Factor** | CF | 0.001 | liter/cm³ | |
| **Exposure Time (3)** | ET | 2 | hours/event | Assumption |
| **Exposure Frequency (3)** | EF | 6 | event/year | Assumption |
| **Exposure Period** | EP | 10 | years | Assumption |
| **Averaging Time** | | | | |
| **Cancer** | ATc | 75 | years | MADEP, 1995 |
| **Noncancer** | ATn | 10 | years | Assumption |
| **Relative Absorption Factor (RAF)** | | | | |
| **Oral** | RAFo | listed below | unitless | MADEP, 1995 |
| **Dermal** | RAFd | listed below | unitless | MADEP, 1995 |
| **Permeability Constant** | Kp | listed below | cm/hour | MADEP, 1995 |

(1) Assumption: 1/10 the amount for swimming.
(2) 50th percentile of surface areas/body weights for males aged 7 through 16: hands, forearms, legs, feet.
(3) 2 events per month June through August, 2 hours per event.
MADEP, 1995. "Guidance for Disposal Site Risk Characterization."

EQUATIONS

**CANCER RISK = LADD (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)^-1**

**HAZARD QUOTIENT = ADD (mg/kg-day) / REFERENCE DOSE (mg/kg-day)**

$$\text{LADD-INGESTION} = \frac{OHMsw \times IR \times RAFI \times EF \times EP \times ET}{BW \times ATc \times 365 \text{ days/yr}}$$

$$\text{ADD-INGESTION} = \frac{OHMsw \times IR \times RAFI \times EF \times EP \times ET}{BW \times ATn \times 365 \text{ days/yr}}$$

$$\text{LADD-DERMAL} = \frac{OHMsw \times SA \times Kp \times RAFd \times CF \times ET \times EF \times EP}{BW \times ATc \times 365 \text{ days/yr}}$$

$$\text{ADD-DERMAL} = \frac{OHMsw \times SA \times Kp \times RAFd \times CF \times ET \times EF \times EP}{BW \times ATn \times 365 \text{ days/yr}}$$

**Note:**

*For noncarcinogenic risk, AT = EP*

TRSWEDR
INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER - EAST DITCH
RECEPTOR: NEIGHBORHOOD RESIDENT WADING (AGES 7 THROUGH 16) - CURRENT LAND USE; RECENT DATA
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A9-5

CARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | DERMAL RAF | INTAKE DERMAL (mg/kg-day) | CANCER SLOPE FACTOR (mg/kg-day)^-1 | CANCER RISK INGESTION | CANCER RISK DERMAL | TOTAL CANCER RISK |
|---|---|---|---|---|---|---|---|---|---|---|
| There are no potentially carcinogenic OHM of concern. | | | | | | | | | | |
| | | | | | | SUMMARY CANCER RISK | | 0E+00 | 0E+00 | 0E+00 |

**TRSWEDR**
**INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER - EAST DITCH**
**RECEPTOR: NEIGHBORHOOD RESIDENT WADING (AGES 7 THROUGH 16) - CURRENT LAND USE; RECENT DATA**
**OLIN CORPORATION**
**WILMINGTON, MA FACILITY**
**TABLE A9-5**
**NONCARCINOGENIC EFFECTS**

| CHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | DERMAL RAF | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|---|
| Aluminum | 1.6 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Barium | 0.019 | 0.73 | 5.4E-08 | 1.0E-03 | 1.82 | 1.8E-07 | 7.0E-02 | 7.7E-07 | 2.5E-06 | 3.3E-06 |
| Calcium | 56 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Chromium | 0.023 | 1.00 | 9.0E-08 | 1.0E-03 | 5.76 | 6.8E-07 | 1.0E+00 | 9.0E-08 | 6.8E-07 | 7.7E-07 |
| Iron | 0.54 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Magnesium | 4.7 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Manganese | 0.26 | 1.90 | 1.9E-06 | 1.0E-03 | 5.76 | 7.7E-06 | 4.7E-02 | 4.1E-05 | 1.6E-04 | 2.1E-04 |
| Potassium | 1.9 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Sodium | 120 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Chloride | 120 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Nitrate as N | 2.7 | 0.73 | 7.7E-06 | 1.0E-03 | 1.82 | 2.5E-05 | 1.6E+00 | 4.8E-06 | 1.6E-05 | 2.1E-05 |
| Nitrogen, Ammonia | 28 | 0.73 | 8.0E-05 | 1.0E-03 | 1.82 | 2.6E-04 | 3.7E-01 | 2.2E-04 | 7.1E-04 | 9.2E-04 |
| Sulfate as SO4 | 280 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Sulfide | 2 | | | 1.0E-03 | | 0.0E+00 | | | | |
| | | | | | | SUMMARY HAZARD INDEX | | 3E-04 | 9E-04 | 1E-03 |

TRSWWDR
INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER - WEST DITCH
RECEPTOR: NEIGHBORHOOD RESIDENT WADING (AGES 7 THROUGH 16) - CURRENT LAND USE; RECENT DATA
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A9-6
EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| Concentration in Surface Water | OHMsw | hemical-specific | mg/liter | |
| Lifetime Average Daily Dose | LADD | alculated below | | MADEP, 1995 |
| Average Daily Dose | ADD | alculated below | | MADEP, 1995 |
| Ingestion Rate (1) | IR | 0.005 | liters/hour | Assumption |
| Surface Area Exposed (2) | SA | 6,578 | $cm^2$ | MADEP, 1995 |
| Body Weight (2) | BW | 42 | kg | MADEP, 1995 |
| Conversion Factor | CF | 0.001 | liter/$cm^3$ | |
| Exposure Time (3) | ET | 2 | hours/event | Assumption |
| Exposure Frequency (3) | EF | 6 | event/year | Assumption |
| Exposure Period | EP | 10 | years | Assumption |
| Averaging Time | | | | |
| Cancer | ATc | 75 | years | MADEP, 1995 |
| Noncancer | ATn | 10 | years | Assumption |
| Relative Absorption Factor (RAF) | | | | |
| Oral | RAFo | listed below | unitless | MADEP, 1995 |
| Dermal | RAFd | listed below | unitless | MADEP, 1995 |
| Permeability Constant | Kp | listed below | cm/hour | MADEP, 1995 |

(1) Assumption: 1/10 the amount for swimming.
(2) 50th percentile of surface areas/body weights for males aged 7 through 16: hands, forearms, legs, feet.
(3) 2 events per month June through August, 2 hours per event.
MADEP, 1995. "Guidance for Disposal Site Risk Characterization."

EQUATIONS

CANCER RISK = LADD (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)^-1)

HAZARD QUOTIENT = ADD (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{LADD-INGESTION} = \frac{\text{OHMsw x IR x RAFI x EF x EP x ET}}{\text{BW x ATc x 365 days/yr}}$$

$$\text{ADD-INGESTION} = \frac{\text{OHMsw x IR x RAFI x EF x EP x ET}}{\text{BW x ATn x 365 days/yr}}$$

$$\text{LADD-DERMAL} = \frac{\text{OHMsw x SA x Kp x RAFd x CF x ET x EF x EP}}{\text{BW x ATc x 365 days/yr}}$$

$$\text{ADD-DERMAL} = \frac{\text{OHMsw x SA x Kp x RAFd x CF x ET x EF x EP}}{\text{BW x ATn x 365 days/yr}}$$

Note:

For noncarcinogenic risk, AT = EP

TRSWWDR
INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER - WEST DITCH
RECEPTOR: NEIGHBORHOOD RESIDENT WADING (AGES 7 THROUGH 16) - CURRENT LAND USE; RECENT DATA
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A9-6

CARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | DERMAL RAF | INTAKE DERMAL (mg/kg-day) | CANCER SLOPE FACTOR (mg/kg-day)^-1 | CANCER RISK INGESTION | CANCER RISK DERMAL | TOTAL CANCER RISK |
|---|---|---|---|---|---|---|---|---|---|---|
| There are no potentially carcinogenic OHM of concern. | | | | | | | | | | |
| | | | | | | SUMMARY CANCER RISK | | 0E+00 | 0E+00 | 0E+00 |

TRSWWDR
INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER - WEST DITCH
RECEPTOR: NEIGHBORHOOD RESIDENT WADING (AGES 7 THROUGH 16) - CURRENT LAND USE; RECENT DATA
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A9-6
NONCARCINOGENIC EFFECTS

| OHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | DERMAL RAF | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|---|
| Aluminum | 0.1567 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Barium | 0.015 | 0.73 | 4.3E-08 | 1.0E-03 | 1.82 | 1.4E-07 | 7.0E-02 | 6.1E-07 | 2.0E-06 | 2.6E-06 |
| Calcium | 11.1 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Iron | 2.4283 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Magnesium | 1.6033 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Manganese | 0.2007 | 1.90 | 1.5E-06 | 1.0E-03 | 5.76 | 6.0E-06 | 4.7E-02 | 3.2E-05 | 1.3E-04 | 1.6E-04 |
| Potassium | 2.5333 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Sodium | 49.3333 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Chloride | 63 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Nitrate as N | 0.425 | 0.73 | 1.2E-06 | 1.0E-03 | 1.82 | 4.0E-06 | 1.6E+00 | 7.6E-07 | 2.5E-06 | 3.2E-06 |
| Nitrogen, Ammonia | 2.3083 | 0.73 | 6.6E-06 | 1.0E-03 | 1.82 | 2.2E-05 | 3.7E-01 | 1.8E-05 | 5.8E-05 | 7.6E-05 |
| Sulfate as SO4 | 36.3333 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Sulfide | 1 | | | 1.0E-03 | | 0.0E+00 | | | | |
| | | | | | | | SUMMARY HAZARD INDEX | 5E-05 | 2E-04 | 2E-04 |

TRSWALH
INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER - ALL DITCHES
RECEPTOR: NEIGHBORHOOD RESIDENT WADING (AGES 7 THROUGH 16) - FUTURE LAND USE; HISTORICAL DATA
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A9-7
EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| **Concentration in Surface Water** | OHMsw | hemical-specific | mg/liter | |
| **Lifetime Average Daily Dose** | LADD | alculated below | | MADEP, 1995 |
| **Average Daily Dose** | ADD | alculated below | | MADEP, 1995 |
| **Ingestion Rate (1)** | IR | 0.005 | liters/hour | Assumption |
| **Surface Area Exposed (2)** | SA | 6,578 | $cm^2$ | MADEP, 1995 |
| **Body Weight (2)** | BW | 42 | kg | MADEP, 1995 |
| **Conversion Factor** | CF | 0.001 | $liter/cm^3$ | |
| **Exposure Time (3)** | ET | 2 | hours/event | Assumption |
| **Exposure Frequency (3)** | EF | 6 | event/year | Assumption |
| **Exposure Period** | EP | 10 | years | Assumption |
| **Averaging Time** | | | | |
| **Cancer** | ATc | 75 | years | MADEP, 1995 |
| **Noncancer** | ATn | 10 | years | Assumption |
| **Relative Absorption Factor (RAF)** | | | | |
| **Oral** | RAFo | listed below | unitless | MADEP, 1995 |
| **Dermal** | RAFd | listed below | unitless | MADEP, 1995 |
| **Permeability Constant** | Kp | listed below | cm/hour | MADEP, 1995 |

(1) Assumption: 1/10 the amount for swimming.
(2) 50th percentile of surface areas/body weights for males aged 7 through 16: hands, forearms, legs, feet.
(3) 2 events per month June through August, 2 hours per event.
MADEP, 1995. "Guidance for Disposal Site Risk Characterization."

EQUATIONS

**CANCER RISK = LADD (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)^-1**

**HAZARD QUOTIENT = ADD (mg/kg-day) / REFERENCE DOSE (mg/kg-day)**

$$\text{LADD-INGESTION} = \frac{OHMsw \times IR \times RAFi \times EF \times EP \times ET}{BW \times ATc \times 365\ \text{days/yr}}$$

$$\text{ADD-INGESTION} = \frac{OHMsw \times IR \times RAFi \times EF \times EP \times ET}{BW \times ATn \times 365\ \text{days/yr}}$$

$$\text{LADD-DERMAL} = \frac{OHMsw \times SA \times Kp \times RAFd \times CF \times ET \times EF \times EP}{BW \times ATc \times 365\ \text{days/yr}}$$

$$\text{ADD-DERMAL} = \frac{OHMsw \times SA \times Kp \times RAFd \times CF \times ET \times EF \times EP}{BW \times ATn \times 365\ \text{days/yr}}$$

**Note:**

*For noncarcinogenic risk, AT = EP*

TRSWALH
INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER - ALL DITCHES
RECEPTOR: NEIGHBORHOOD RESIDENT WADING (AGES 7 THROUGH 16) - FUTURE LAND USE; HISTORICAL DATA
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A9-7
CARCINOGENIC EFFECTS

| CHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | DERMAL RAF | INTAKE DERMAL (mg/kg-day) | CANCER SLOPE FACTOR (mg/kg-day)^-1 | CANCER RISK INGESTION | CANCER RISK DERMAL | TOTAL CANCER RISK |
|---|---|---|---|---|---|---|---|---|---|---|
| Bromoform | 0.0016 | 1.00 | 8.5E-10 | 2.6E-03 | 1.00 | 2.9E-09 | 7.9E-03 | 6.7E-12 | 2.3E-11 | 3.0E-11 |
| Methylene Chloride | 0.0030 | 1.00 | 1.6E-09 | 4.5E-03 | 1.00 | 9.3E-09 | 7.5E-03 | 1.2E-11 | 7.0E-11 | 8.1E-11 |
| Trichloroethene (TCE) | 0.0033 | 1.00 | 1.7E-09 | 2.3E-01 | 1.00 | 5.2E-07 | 1.5E-02 | 2.6E-11 | 7.8E-09 | 7.8E-09 |
| Vinyl Chloride | 0.0014 | 1.53 | 1.1E-09 | 7.3E-03 | 1.02 | 7.3E-09 | 1.9E+00 | 2.2E-09 | 1.4E-08 | 1.6E-08 |
| N-Nitrosodiphenylamine | 0.0038 | 0.92 | 1.8E-09 | 5.3E-03 | 1.00 | 1.4E-08 | 4.9E-03 | 8.9E-12 | 6.7E-11 | 7.6E-11 |
| bis(2-EthylHexyl)phthalate | 0.0130 | 1.00 | 6.8E-09 | 1.0E-03 | 1.05 | 9.4E-09 | 1.4E-02 | 9.5E-11 | 1.3E-10 | 2.3E-10 |
| Arsenic | 0.0147 | 1.00 | 7.6E-09 | 1.0E-03 | 1.82 | 1.8E-08 | 1.5E+00 | 1.1E-08 | 2.7E-08 | 3.9E-08 |
| Lead | 0.0114 | | | | | | ND | | | |
| | | | | | | | SUMMARY CANCER RISK | 1E-08 | 5E-08 | 6E-08 |

TRSWALH
INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER - ALL DITCHES
RECEPTOR: NEIGHBORHOOD RESIDENT WADING (AGES 7 THROUGH 16) - FUTURE LAND USE; HISTORICAL DATA
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A9-7
NONCARCINOGENIC EFFECTS

| CHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | DERMAL RAF | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|---|
| 1,1,1-Trichloroethane | 0.0016 | 1.00 | 6.4E-09 | 1.7E-02 | 1.00 | 1.4E-07 | 9.0E-01 | 7.1E-09 | 1.6E-07 | 1.7E-07 |
| 1,2-Dichloroethene(total) | 0.0023 | 1.00 | 9.2E-09 | 1.0E-02 | 1.00 | 1.2E-07 | 9.0E-03 | 1.0E-06 | 1.3E-05 | 1.4E-05 |
| 2,4,4-Trimethyl-1-pentene | 0.0142 | 0.99 | 5.5E-08 | 2.3E-01 | 1.00 | 1.7E-05 | 2.1E-01 | 2.7E-07 | 8.3E-05 | 8.3E-05 |
| 2,4,4-Trimethyl-2-Pentene | 0.0070 | 0.99 | 2.7E-08 | 2.3E-01 | 1.00 | 8.4E-06 | 2.1E-01 | 1.3E-07 | 4.1E-05 | 4.1E-05 |
| 4-Methyl-2-Pentanone (MIBK) | 0.0014 | 1.00 | 5.6E-09 | 3.4E-03 | 1.00 | 2.5E-08 | 8.0E-02 | 6.9E-08 | 3.1E-07 | 3.8E-07 |
| Acetone | 0.0068 | 1.00 | 2.7E-08 | 5.7E-04 | 1.00 | 2.0E-08 | 1.0E-01 | 2.7E-07 | 2.0E-07 | 4.7E-07 |
| Bromoform | 0.0016 | 1.00 | 6.4E-09 | 2.6E-03 | 1.00 | 2.2E-08 | 2.0E-02 | 3.2E-07 | 1.1E-06 | 1.4E-06 |
| Chloroethane | 0.0032 | 1.00 | 1.2E-08 | 8.0E-03 | 1.00 | 1.3E-07 | 4.0E-03 | 3.1E-06 | 3.3E-05 | 3.6E-05 |
| Ethylbenzene | 0.0014 | 1.00 | 5.5E-09 | 1.0E+00 | 1.00 | 7.2E-06 | 1.0E-01 | 5.5E-08 | 7.2E-05 | 7.2E-05 |
| Methylene Chloride | 0.0030 | 1.00 | 1.2E-08 | 4.5E-03 | 1.00 | 7.0E-08 | 6.0E-02 | 2.0E-07 | 1.2E-06 | 1.4E-06 |
| Toluene | 0.0127 | 1.00 | 5.0E-08 | 1.0E+00 | 1.00 | 6.5E-05 | 2.0E-01 | 2.5E-07 | 3.3E-04 | 3.3E-04 |
| Trichloroethene (TCE) | 0.0033 | 1.00 | 1.3E-08 | 2.3E-01 | 1.10 | 4.3E-06 | 2.0E-03 | 6.4E-06 | 2.1E-03 | 2.1E-03 |
| Vinyl Chloride | 0.0014 | 1.00 | 5.6E-09 | 7.3E-03 | 1.02 | 5.4E-08 | 1.0E-03 | 5.6E-06 | 5.4E-05 | 6.0E-05 |
| Xylenes, Total | 0.0029 | 1.00 | 1.1E-08 | 8.0E-02 | 1.00 | 1.2E-06 | 2.0E+00 | 5.6E-09 | 5.9E-07 | 6.0E-07 |
| Di-n-octylphthalate | 0.0049 | 0.97 | 1.9E-08 | 2.9E+01 | 1.05 | 7.6E-04 | 2.0E-02 | 9.3E-07 | 3.8E-02 | 3.8E-02 |
| N-Nitrosodiphenylamine | 0.0038 | 0.97 | 1.4E-08 | 1.9E-02 | 1.05 | 3.8E-07 | 5.0E-02 | 2.9E-07 | 7.6E-06 | 7.9E-06 |
| Phenol | 0.0024 | 1.00 | 9.5E-09 | 8.2E-03 | 1.10 | 1.1E-07 | 6.0E-01 | 1.6E-08 | 1.9E-07 | 2.0E-07 |
| bis(2-EthylHexyl)phthalate | 0.0130 | 1.00 | 5.1E-08 | 5.3E-03 | 1.05 | 3.7E-07 | 2.0E-02 | 2.6E-06 | 1.9E-05 | 2.1E-05 |
| Aluminum | 4.6965 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Arsenic | 0.0147 | 1.00 | 5.7E-08 | 1.0E-03 | 1.82 | 1.4E-07 | 3.0E-04 | 1.9E-04 | 4.6E-04 | 6.5E-04 |
| Barium | 0.0244 | 0.73 | 7.0E-08 | 1.0E-03 | 1.82 | 2.3E-07 | 7.0E-02 | 9.9E-07 | 3.3E-06 | 4.3E-06 |
| Calcium | 33.3247 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Chromium | 0.6704 | 1.00 | 2.6E-06 | 1.0E-03 | 5.76 | 2.0E-05 | 1.0E+00 | 2.6E-06 | 2.0E-05 | 2.3E-05 |
| Cobalt | 0.0137 | 1.90 | 1.0E-07 | 1.0E-03 | 5.76 | 4.1E-07 | 6.0E-02 | 1.7E-06 | 6.8E-06 | 8.5E-06 |
| Copper | 0.0127 | | | 1.0E-03 | | 0.0E+00 | | | | |

TRSWALH
INGESTION OF AND DIRECT CONTACT WITH SURFACE WATER - ALL DITCHES
RECEPTOR: NEIGHBORHOOD RESIDENT WADING (AGES 7 THROUGH 16) - FUTURE LAND USE; HISTORICAL DATA
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A9-7
NONCARCINOGENIC EFFECTS (continued)

| CHM | WATER CONCENTRATION (mg/l) | ORAL RAF | INTAKE INGESTION (mg/kg-day) | Kp (cm/hr) | DERMAL RAF | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|---|
| Hexavalent Chromium | 0.0266 | 1.00 | 1.0E-07 | 1.0E-03 | 1.82 | 2.5E-07 | 5.0E-03 | 2.1E-05 | 5.0E-05 | 7.1E-05 |
| Iron | 5.5796 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Lead | 0.0114 | 0.50 | 2.2E-08 | 1.0E-03 | 3.00 | 1.8E-07 | 7.5E-04 | 3.0E-05 | 2.3E-04 | 2.6E-04 |
| Magnesium | 5.2938 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Manganese | 0.8541 | 1.90 | 6.4E-06 | 1.0E-03 | 5.76 | 2.5E-05 | 4.7E-02 | 1.4E-04 | 5.4E-04 | 6.7E-04 |
| Mercury | 0.0001 | 1.90 | 4.3E-10 | 1.0E-03 | 5.76 | 1.7E-09 | 3.0E-04 | 1.4E-06 | 5.7E-06 | 7.2E-06 |
| Nickel | 0.0185 | 1.00 | 7.2E-08 | 1.0E-03 | 5.76 | 5.5E-07 | 2.0E-02 | 3.6E-06 | 2.7E-05 | 3.1E-05 |
| Potassium | 2.7056 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Sodium | 97.0600 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Vanadium | 0.0101 | 0.73 | 2.9E-08 | 1.0E-03 | 1.82 | 9.4E-08 | 7.0E-03 | 4.1E-06 | 1.3E-05 | 1.8E-05 |
| Zinc | 0.0703 | 1.00 | 2.8E-07 | 1.0E-03 | 5.76 | 2.1E-06 | 3.0E-01 | 9.2E-07 | 7.0E-06 | 7.9E-06 |
| Chloride | 108.0708 | | | 1.0E-03 | | 0.0E+00 | | | | |
| Nitrate as N | 2.6684 | 0.73 | 7.6E-06 | 1.0E-03 | 1.82 | 2.5E-05 | 1.6E+00 | 4.7E-06 | 1.6E-05 | 2.0E-05 |
| Nitrite as N | 0.0432 | 0.73 | 1.2E-07 | 1.0E-03 | 1.82 | 4.1E-07 | 1.0E-01 | 1.2E-06 | 4.1E-06 | 5.3E-06 |
| Nitrogen, Ammonia | 27.2923 | 0.73 | 7.8E-05 | 1.0E-03 | 1.82 | 2.6E-04 | 3.7E-01 | 2.1E-04 | 6.9E-04 | 9.0E-04 |
| Sulfate as SO4 | 236.2310 | | | 1.0E-03 | | 0.0E+00 | | | | |
| | | | | | | | SUMMARY HAZARD INDEX | 6E-04 | 4E-02 | 4E-02 |

TRSDIDAL
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SEDIMENT - ALL DITCHES
RECEPTOR: NEIGHBORHOOD RESIDENT (AGES 7 THROUGH 16) - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A10-4

22-May-97

NONCARCINOGENIC EFFECTS

| COMPOUND | SEDIMENT CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|
| 1,1,1-Trichloroethane | 1.009 | 1.00 | 2.0E-08 | 0.10 | 9.1E-08 | 9.0E-01 | 2.2E-08 | 1.0E-07 | 1.2E-07 |
| 1,1,2,2-Tetrachloroethane | 0.004 | 0.99 | 8.5E-11 | 0.11 | 4.3E-10 | 3.0E-02 | 2.8E-09 | 1.4E-08 | 1.7E-08 |
| 1,1-Dichloroethane | 0.017 | 1.30 | 4.5E-10 | 0.13 | 2.1E-09 | 1.0E-01 | 4.5E-09 | 2.1E-08 | 2.5E-08 |
| 1,2-Dichloroethene(total) | 0.019 | 1.00 | 3.6E-10 | 0.10 | 1.7E-09 | 9.0E-03 | 4.1E-08 | 1.9E-07 | 2.3E-07 |
| 1,2-Dichloropropane | 0.016 | 0.99 | 3.2E-10 | 0.11 | 1.6E-09 | 6.2E-01 | 5.1E-10 | 2.6E-09 | 3.1E-09 |
| 2,4,4-Trimethyl-1-pentene | 1.606 | 0.99 | 3.1E-08 | 0.11 | 1.6E-07 | 2.1E-01 | 1.5E-07 | 7.8E-07 | 9.3E-07 |
| 2,4,4-Trimethyl-2-Pentene | 0.512 | 0.99 | 9.9E-09 | 0.11 | 5.1E-08 | 2.1E-01 | 4.8E-08 | 2.5E-07 | 3.0E-07 |
| 2-Butanone (MEK) | 0.061 | 1.00 | 1.2E-09 | 0.10 | 5.5E-09 | 6.0E-01 | 2.0E-09 | 9.1E-09 | 1.1E-08 |
| 2-Hexanone | 0.027 | 1.00 | 5.2E-10 | 0.10 | 2.4E-09 | 6.0E-01 | 8.7E-10 | 4.0E-09 | 4.9E-09 |
| Acetone | 0.175 | 1.00 | 3.4E-09 | 0.10 | 1.6E-08 | 1.0E-01 | 3.4E-08 | 1.6E-07 | 1.9E-07 |
| Benzene | 0.013 | 1.00 | 2.6E-10 | 0.08 | 9.6E-10 | 5.0E-03 | 5.2E-08 | 1.9E-07 | 2.4E-07 |
| Bromodichloromethane | 0.005 | 1.00 | 9.4E-11 | 0.10 | 4.3E-10 | 2.0E-02 | 4.7E-09 | 2.2E-08 | 2.6E-08 |
| Bromoform | 0.020 | 1.00 | 3.9E-10 | 0.11 | 2.0E-09 | 2.0E-02 | 1.9E-08 | 9.8E-08 | 1.2E-07 |
| Carbon Disulfide | 0.004 | 1.09 | 7.9E-11 | 0.12 | 4.0E-10 | 1.0E-01 | 7.9E-10 | 4.0E-09 | 4.8E-09 |
| Carbon Tetrachloride | 0.008 | 1.00 | 1.6E-10 | 0.10 | 7.3E-10 | 7.0E-04 | 2.3E-07 | 1.0E-06 | 1.3E-06 |
| Chlorobenzene | 0.010 | 1.00 | 2.0E-10 | 0.10 | 9.3E-10 | 2.0E-02 | 1.0E-08 | 4.7E-08 | 5.7E-08 |
| Chloroform | 0.007 | 1.00 | 1.3E-10 | 0.10 | 6.0E-10 | 1.0E-02 | 1.3E-08 | 6.0E-08 | 7.3E-08 |
| Dibromochloromethane | 0.017 | 1.00 | 3.3E-10 | 0.10 | 1.5E-09 | 2.0E-02 | 1.6E-08 | 7.5E-08 | 9.1E-08 |
| Ethylbenzene | 0.023 | 1.00 | 4.5E-10 | 0.20 | 4.2E-09 | 1.0E-01 | 4.5E-09 | 4.2E-08 | 4.6E-08 |
| Methylene Chloride | 0.019 | 1.00 | 3.7E-10 | 0.10 | 1.7E-09 | 6.0E-02 | 6.1E-09 | 2.8E-08 | 3.5E-08 |
| Styrene | 0.005 | 1.00 | 1.0E-10 | 0.20 | 9.3E-10 | 2.0E-01 | 5.1E-10 | 4.7E-09 | 5.2E-09 |
| Tetrachloroethene (PCE) | 0.016 | 1.00 | 3.2E-10 | 0.10 | 1.5E-09 | 1.0E-02 | 3.2E-08 | 1.5E-07 | 1.8E-07 |
| Toluene | 0.041 | 1.00 | 8.0E-10 | 0.12 | 4.4E-09 | 2.0E-01 | 4.0E-09 | 2.2E-08 | 2.6E-08 |
| Trichloroethene (TCE) | 0.022 | 1.00 | 4.3E-10 | 0.10 | 2.0E-09 | 2.0E-03 | 2.1E-07 | 9.8E-07 | 1.2E-06 |
| Vinyl Chloride | 0.009 | 1.00 | 1.7E-10 | 0.10 | 8.0E-10 | 1.0E-03 | 1.7E-07 | 8.0E-07 | 9.8E-07 |
| Xylenes, Total | 0.023 | 1.00 | 4.4E-10 | 0.12 | 2.5E-09 | 2.0E+00 | 2.2E-10 | 1.2E-09 | 1.5E-09 |
| 1,2,4-Trichlorobenzene | 1.036 | 1.00 | 2.0E-08 | 0.08 | 7.5E-08 | 1.0E-02 | 2.0E-06 | 7.5E-06 | 9.5E-06 |
| 1,2-Dichlorobenzene | 1.184 | 1.00 | 2.3E-08 | 0.10 | 1.1E-07 | 9.0E-02 | 2.6E-07 | 1.2E-06 | 1.4E-06 |
| 2-Methylnaphthalene | 1.053 | 1.00 | 2.1E-08 | 0.20 | 1.9E-07 | 3.0E-02 | 6.9E-07 | 6.3E-06 | 7.0E-06 |
| 4-Bromophenyl-phenylether | 2.576 | | | | | | | | |
| 4-Chlorophenyl-phenylether | 1.759 | | | | | | | | |
| Anthracene | 0.197 | 1.00 | 3.9E-09 | 0.29 | 5.2E-08 | 3.0E-01 | 1.3E-08 | 1.7E-07 | 1.8E-07 |
| Benzo(a)Anthracene | 1.679 | 0.91 | 3.0E-08 | 0.18 | 2.7E-07 | 3.0E-02 | 1.0E-06 | 9.1E-06 | 1.0E-05 |
| Benzo(a)Pyrene | 0.614 | 0.91 | 1.1E-08 | 0.18 | 1.0E-07 | 3.0E-02 | 3.6E-07 | 3.3E-06 | 3.7E-06 |
| Benzo(b)Fluoranthene | 1.119 | 0.91 | 2.0E-08 | 0.18 | 1.8E-07 | 3.0E-02 | 6.6E-07 | 6.1E-06 | 6.7E-06 |
| Benzo(g,h,i)Perylene | 0.557 | 0.91 | 9.9E-09 | 0.18 | 9.1E-08 | 3.0E-02 | 3.3E-07 | 3.0E-06 | 3.3E-06 |
| Benzo(k)Fluoranthene | 0.406 | 0.91 | 7.2E-09 | 0.18 | 6.6E-08 | 3.0E-02 | 2.4E-07 | 2.2E-06 | 2.4E-06 |
| Benzoic Acid | 2.892 | 0.96 | 5.4E-08 | 0.18 | 4.7E-07 | 4.0E+00 | 1.4E-08 | 1.2E-07 | 1.3E-07 |
| Butylbenzylphthalate | 38.403 | 0.96 | 7.2E-07 | 0.18 | 6.2E-06 | 2.0E-01 | 3.6E-06 | 3.1E-05 | 3.5E-05 |
| Chrysene | 1.159 | 0.91 | 2.1E-08 | 0.18 | 1.9E-07 | 3.0E-02 | 6.9E-07 | 6.3E-06 | 7.0E-06 |
| Di-n-butylphthalate | 86.353 | 0.96 | 1.6E-06 | 0.18 | 1.4E-05 | 1.0E-01 | 1.6E-05 | 1.4E-04 | 1.6E-04 |
| Di-n-octylphthalate | 17.857 | 0.96 | 3.3E-07 | 0.18 | 2.9E-06 | 2.0E-02 | 1.7E-05 | 1.4E-04 | 1.6E-04 |
| Dibenzo(a,h)Anthracene | 0.161 | 0.91 | 2.9E-09 | 0.08 | 1.2E-08 | 3.0E-02 | 9.5E-08 | 3.9E-07 | 4.8E-07 |
| Dibenzofuran | 4.423 | 1.00 | 8.7E-08 | 0.19 | 7.5E-07 | 3.0E-02 | 2.9E-06 | 2.5E-05 | 2.8E-05 |
| Dimethylphthalate | 0.392 | 1.00 | 7.7E-09 | 0.07 | 2.5E-08 | 1.0E+00 | 7.7E-09 | 2.5E-08 | 3.2E-08 |
| Fluoranthene | 3.328 | 1.00 | 6.5E-08 | 0.20 | 6.0E-07 | 4.0E-02 | 1.6E-06 | 1.5E-05 | 1.7E-05 |
| Fluorene | 3.038 | 1.00 | 5.9E-08 | 0.20 | 5.5E-07 | 4.0E-02 | 1.5E-06 | 1.4E-05 | 1.5E-05 |
| Indeno (1,2,3-cd)Pyrene | 9.755 | 0.91 | 1.7E-07 | 0.18 | 1.6E-06 | 3.0E-02 | 5.8E-06 | 5.3E-05 | 5.9E-05 |
| N-Nitrosodiphenylamine | 221.085 | 0.96 | 4.1E-06 | 0.18 | 3.6E-05 | 5.0E-02 | 8.3E-05 | 7.1E-04 | 8.0E-04 |
| Naphthalene | 2.476 | 1.00 | 4.8E-08 | 0.10 | 2.2E-07 | 4.0E-02 | 1.2E-06 | 5.6E-06 | 6.8E-06 |

[1] MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
ND = no data available

TRSDIDAL
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SEDIMENT - ALL DITCHES
RECEPTOR: NEIGHBORHOOD RESIDENT (AGES 7 THROUGH 16) - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A10-4

23-May-97
NONCARCINOGENIC EFFECTS (CONTINUED)

| COMPOUND | SEDIMENT CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|
| Phenanthrene | 25.325 | 0.91 | 4.5E-07 | 0.18 | 4.1E-06 | 3.0E-02 | 1.5E-05 | 1.4E-04 | 1.5E-04 |
| Phenol | 22.993 | 1.00 | 4.5E-07 | 0.26 | 5.4E-06 | 6.0E-01 | 7.5E-07 | 9.0E-06 | 9.7E-06 |
| Pyrene | 6.961 | 1.00 | 1.4E-07 | 0.20 | 1.3E-06 | 3.0E-02 | 4.5E-06 | 4.2E-05 | 4.6E-05 |
| bis(2-EthylHexyl)phthalate | 6154.127 | 1.00 | 1.2E-04 | 0.02 | 1.1E-04 | 2.0E-02 | 6.0E-03 | 5.6E-03 | 1.2E-02 |
| 4,4'-DDD | 0.048 | 0.96 | 9.1E-10 | 0.18 | 7.8E-09 | 5.0E-04 | 1.8E-06 | 1.6E-05 | 1.7E-05 |
| 4,4'-DDT | 0.068 | 0.96 | 1.3E-09 | 0.18 | 1.1E-08 | 5.0E-04 | 2.6E-06 | 2.2E-05 | 2.5E-05 |
| Aldrin | 0.032 | 1.00 | 6.4E-10 | 0.25 | 7.3E-09 | 3.0E-05 | 2.1E-05 | 2.4E-04 | 2.7E-04 |
| Alpha-BHC | 0.004 | 0.96 | 7.2E-11 | 0.18 | 6.2E-10 | 5.0E-04 | 1.4E-07 | 1.2E-06 | 1.4E-06 |
| Alpha-Chlordane | 0.198 | 1.00 | 3.9E-09 | 0.05 | 8.9E-09 | 6.0E-05 | 6.4E-05 | 1.5E-04 | 2.1E-04 |
| Beta-BHC | 0.033 | 0.96 | 6.2E-10 | 0.18 | 5.4E-09 | 5.0E-04 | 1.2E-06 | 1.1E-05 | 1.2E-05 |
| Delta-BHC | 0.027 | 0.96 | 5.1E-10 | 0.18 | 4.4E-09 | 5.0E-04 | 1.0E-06 | 8.9E-06 | 9.9E-06 |
| Endosulfan I | 0.035 | 0.96 | 6.5E-10 | 0.18 | 5.6E-09 | 6.0E-03 | 1.1E-07 | 9.3E-07 | 1.0E-06 |
| Endosulfan Sulfate | 0.057 | 0.96 | 1.1E-09 | 0.18 | 9.1E-09 | 6.0E-03 | 1.8E-07 | 1.5E-06 | 1.7E-06 |
| Endrin | 0.051 | 1.00 | 1.0E-09 | 0.25 | 1.2E-08 | 3.0E-04 | 3.4E-06 | 3.9E-05 | 4.2E-05 |
| Endrin Aldehyde | 0.202 | 0.96 | 3.8E-09 | 0.18 | 3.3E-08 | 3.0E-04 | 1.3E-05 | 1.1E-04 | 1.2E-04 |
| Endrin Ketone | 0.051 | 0.96 | 9.5E-10 | 0.18 | 8.2E-09 | 3.0E-04 | 3.2E-06 | 2.7E-05 | 3.0E-05 |
| Gamma-Chlordane | 0.207 | 1.00 | 4.0E-09 | 0.05 | 9.3E-09 | 6.0E-05 | 6.7E-05 | 1.6E-04 | 2.2E-04 |
| Heptachlor | 0.031 | 1.00 | 6.1E-10 | 0.20 | 5.6E-09 | 5.0E-04 | 1.2E-06 | 1.1E-05 | 1.2E-05 |
| Heptachlor Epoxide | 0.028 | 1.00 | 5.6E-10 | 0.20 | 5.1E-09 | 1.3E-05 | 4.3E-05 | 3.9E-04 | 4.4E-04 |
| Methoxychlor | 0.215 | 1.00 | 4.2E-09 | 0.20 | 3.9E-08 | 5.0E-03 | 8.4E-07 | 7.7E-06 | 8.6E-06 |
| Aluminum | 11568.97 | | | | | | | | |
| Antimony | 24.81 | 1.00 | 4.9E-07 | 0.10 | 2.2E-06 | 4.0E-04 | 1.2E-03 | 5.6E-03 | 6.8E-03 |
| Arsenic | 34.45 | 1.00 | 6.7E-07 | 0.03 | 9.3E-07 | 3.0E-04 | 2.2E-03 | 3.1E-03 | 5.4E-03 |
| Barium | 28.25 | 0.71 | 3.9E-07 | 0.05 | 1.4E-06 | 7.0E-02 | 5.6E-06 | 2.0E-05 | 2.5E-05 |
| Beryllium | 0.80 | 1.00 | 1.6E-08 | 0.03 | 2.2E-08 | 5.0E-03 | 3.1E-06 | 4.4E-06 | 7.5E-06 |
| Cadmium | 1.17 | 1.00 | 2.3E-08 | 0.14 | 1.5E-07 | 5.0E-04 | 4.6E-05 | 3.0E-04 | 3.4E-04 |
| Calcium | 1358.71 | | | | | | | | |
| Chromium III | 1229.40 | 1.00 | 2.4E-05 | 0.04 | 4.4E-05 | 1.0E+00 | 2.4E-05 | 4.4E-05 | 6.8E-05 |
| Cobalt | 6.38 | 1.86 | 2.3E-07 | 0.14 | 8.2E-07 | 6.0E-02 | 3.9E-06 | 1.4E-05 | 1.8E-05 |
| Copper | 34.68 | | | | | | | | |
| Iron | 18928.76 | | | | | | | | |
| Lead | 46.26 | 0.50 | 4.5E-07 | 0.01 | 2.5E-07 | 7.5E-04 | 6.0E-04 | 3.3E-04 | 9.4E-04 |
| Manganese | 139.63 | 1.86 | 5.1E-06 | 0.14 | 1.8E-05 | 4.7E-02 | 1.1E-04 | 3.8E-04 | 4.9E-04 |
| Mercury | 0.24 | 1.00 | 4.7E-09 | 0.05 | 1.1E-08 | 3.0E-04 | 1.6E-05 | 3.6E-05 | 5.1E-05 |
| Nickel | 10.83 | 1.00 | 2.1E-07 | 0.35 | 3.4E-06 | 2.0E-02 | 1.1E-05 | 1.7E-04 | 1.8E-04 |
| Potassium | 452.69 | | | | | | | | |
| Selenium | 0.18 | 1.00 | 3.6E-09 | 0.00 | 3.3E-10 | 5.0E-03 | 7.1E-07 | 6.6E-08 | 7.8E-07 |
| Silver | 1.03 | 1.00 | 2.0E-08 | 0.25 | 2.3E-07 | 5.0E-03 | 4.0E-06 | 4.7E-05 | 5.1E-05 |
| Sodium | 228.40 | | | | | | | | |
| Vanadium | 16.20 | 0.71 | 2.2E-07 | 0.05 | 8.0E-07 | 7.0E-03 | 3.2E-05 | 1.1E-04 | 1.5E-04 |
| Zinc | 91.70 | 1.00 | 1.8E-06 | 0.02 | 1.7E-06 | 3.0E-01 | 6.0E-06 | 5.5E-06 | 1.1E-05 |
| Chloride | 131.15 | | | | | | | | |
| Nitrate as N | 1.35 | 0.71 | 1.9E-08 | 0.05 | 6.6E-08 | 1.6E+00 | 1.2E-08 | 4.1E-08 | 5.3E-08 |
| Nitrite as N | 0.52 | 0.71 | 7.2E-09 | 0.05 | 2.6E-08 | 1.0E-01 | 7.2E-08 | 2.6E-07 | 3.3E-07 |
| Nitrogen, Ammonia | 138.87 | 0.71 | 1.9E-06 | 0.05 | 6.8E-06 | 3.7E-01 | 5.2E-06 | 1.8E-05 | 2.4E-05 |
| Sulfate as SO4 | 1355.26 | | | | | | | | |
| Chromium VI | 136.60 | 1.00 | 2.7E-06 | 0.09 | 1.1E-05 | 5.0E-03 | 5.3E-04 | 2.2E-03 | 2.8E-03 |
| SUMMARY HAZARD INDEX | | | | | | | 1E-02 | 2E-02 | 3E-02 |

[1] MADEP, 1994. *Background Documentation for the Development of MCP Numerical Standards.* April 1994.
ND = no data available

ATTACHMENT 10

# ATTACHMENT 10

# SEDIMENT RISK CALCULATION SPREADSHEETS

MWSDIDOD
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SEDIMENT - ON-SITE DITCH
RECEPTOR: ON-SITE WORKER (MAINTENANCE AND PLANT AREA B) - CURRENT LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A10-1

22-May-97

EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| CONCENTRATION SEDIMENT | $[OHM]_{sediment}$ | chemical specific | chemical-specific | |
| INGESTION RATE | IR | 50 | mg-sediment/day | MADEP, 1995 |
| ADHERENCE FACTOR | AF | 0.51 | mg-sediment/cm²-skin | MADEP, 1995 |
| AVERAGE SURFACE AREA (1) | SA | 3,900 | cm²/day | calculated per MADEP, 1995 |
| RELATIVE ABSORPTION FACTOR-ORAL | RAF-O | chemical specific | unitless | MADEP, 1994, 1995 |
| RELATIVE ABSORPTION FACTOR -DERM | RAF-D | chemical specific | unitless | MADEP, 1994, 1995 |
| CONVERSION FACTOR | CF | 1.00E-06 | kg/mg | |
| BODY WEIGHT | BW | 70 | kg | USEPA, 1989 |
| EXPOSURE PERIOD | EP | 25 | years | USEPA, 1991 |
| EXPOSURE FREQUENCY (2) | EF | 15 ~~3~~ | events/year | Assumption |
| EXPOSURE DURATION (2) | ED | 1 | day/event | Assumption |
| AVERAGING PERIOD | | | | |
| CANCER | AP | 75 | years | MADEP, 1995 |
| NONCANCER | AP | 25 | years | USEPA, 1991 |

(1) 50th percentile of surface areas for males; hands and arms.
(2) 3 events per year, 4 hours per event, over a one-day period (= 1 day per event). These data are based on an interview with facility personnel (9/24/96)

MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
MADEP, 1995. *Guidance for Disposal Site Risk Characterization. Interim Final Policy WSC/ORS-95-141.* July 1995.
USEPA, 1989. Exposure Factors Handbook.EPA/600/8-89/043. May 1989.
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors." OSWER Directive 9285.6-03.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)^-1

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE-INGESTION} = \frac{[OHM]_{sediment} \times IR \times RAF\text{-}O \times CF \times EF \times ED \times EP}{BW \times AP \times 365\ \text{days/yr}}$$

$$\text{INTAKE-DERMAL} = \frac{[OHM]_{sediment} \times SA \times AF \times RAF\text{-}D \times EF \times ED \times EP \times CF}{BW \times AP \times 365\ \text{days/yr}}$$

MWSDIDOD
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SEDIMENT - ON-SITE DITCH
RECEPTOR: ON-SITE WORKER (MAINTENANCE AND PLANT AREA B) - CURRENT LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A10-1

22-May-97

CARCINOGENIC EFFECTS

| COMPOUND | SEDIMENT CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | CANCER SLOPE FACTOR (mg/kg-day)^-1 | CANCER RISK INGESTION | CANCER RISK DERMAL | TOTAL CANCER RISK |
|---|---|---|---|---|---|---|---|---|---|
| 1,1,2,2-Tetrachloroethane | 0.003 | 1.00 | 5.9E-12 | 1.40 | 3.3E-10 | 2.0E-01 | 1.2E-12 | 6.5E-11 | 6.7E-11 |
| 1,1-Dichloroethane | 0.0269 | 0.99 | 5.2E-11 | 0.11 | 2.3E-10 | 5.7E-03 | 3.0E-13 | 1.3E-12 | 1.6E-12 |
| Benzene | 0.015 | 1.00 | 2.9E-11 | 0.08 | 9.3E-11 | 2.9E-02 | 8.5E-13 | 2.7E-12 | 3.6E-12 |
| Methylene Chloride | 0.024 | 1.00 | 4.7E-11 | 0.10 | 1.9E-10 | 7.5E-03 | 3.5E-13 | 1.4E-12 | 1.8E-12 |
| Tetrachloroethene (PCE) | 0.0266 | 1.00 | 5.2E-11 | 0.10 | 2.1E-10 | 5.1E-02 | 2.7E-12 | 1.1E-11 | 1.3E-11 |
| Benzo(a)Anthracene | 2.1 | 1.00 | 4.1E-09 | 0.20 | 3.3E-08 | 7.3E-01 | 3.0E-09 | 2.4E-08 | 2.7E-08 |
| Benzo(a)Pyrene | 0.1 | 1.00 | 2.0E-10 | 0.20 | 1.6E-09 | 7.3E+00 | 1.4E-09 | 1.1E-08 | 1.3E-08 |
| Benzo(b)Fluoranthene | 0.87 | 1.00 | 1.7E-09 | 0.20 | 1.4E-08 | 7.3E-01 | 1.2E-09 | 9.9E-09 | 1.1E-08 |
| Butylbenzylphthalate | 57.6357 | | | | | ND | | | |
| Chrysene | 1.3 | 1.00 | 2.5E-09 | 0.20 | 2.0E-08 | 7.3E-03 | 1.9E-11 | 1.5E-10 | 1.7E-10 |
| Indeno (1,2,3-cd)Pyrene | 13 | 1.00 | 2.5E-08 | 0.20 | 2.0E-07 | 7.3E-01 | 1.9E-08 | 1.5E-07 | 1.7E-07 |
| N-Nitrosodiphenylamine | 422.6209 | 0.91 | 7.5E-07 | 0.17 | 5.6E-06 | 4.9E-03 | 3.7E-09 | 2.7E-08 | 3.1E-08 |
| bis(2-EthylHexyl)phthalate | 11092.8642 | 1.00 | 2.2E-05 | 0.02 | 1.7E-05 | 1.4E-02 | 3.0E-07 | 2.4E-07 | 5.5E-07 |
| 4,4'-DDT | 0.0958 | 1.00 | 1.9E-10 | 0.20 | 1.5E-09 | 3.4E-01 | 6.4E-11 | 5.1E-10 | 5.7E-10 |
| Aldrin | 0.0469 | 1.00 | 9.2E-11 | 0.25 | 9.1E-10 | 1.7E+01 | 1.6E-09 | 1.6E-08 | 1.7E-08 |
| Alpha-Chlordane | 0.025 | 1.00 | 4.9E-11 | 0.05 | 9.7E-11 | 1.3E+00 | 6.4E-11 | 1.3E-10 | 1.9E-10 |
| Beta-BHC | 0.0438 | 0.96 | 8.2E-11 | 0.18 | 6.1E-10 | 1.8E+00 | 1.5E-10 | 1.1E-09 | 1.2E-09 |
| Heptachlor | 0.0441 | 1.00 | 8.6E-11 | 0.20 | 6.9E-10 | 4.5E+00 | 3.9E-10 | 3.1E-09 | 3.5E-09 |
| Heptachlor Epoxide | 0.006 | 1.00 | 1.2E-11 | 0.20 | 9.3E-11 | 9.1E+00 | 1.1E-10 | 8.5E-10 | 9.6E-10 |
| Arsenic | 4.7845 | 1.00 | 9.4E-09 | 0.03 | 1.1E-08 | 1.5E+00 | 1.4E-08 | 1.7E-08 | 3.1E-08 |
| Beryllium | 1.0353 | 1.00 | 2.0E-09 | 0.03 | 2.4E-09 | 4.3E+00 | 8.7E-09 | 1.0E-08 | 1.9E-08 |
| Cadmium | 0.6029 | | | | | ND | | | |
| Lead | 13.6179 | | | | | ND | | | |
| | | | | | SUMMARY CANCER RISK | | 4E-07 | 5E-07 | 9E-07 |

[1] MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
ND = no data available

MWSDIDOD
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SEDIMENT - ON-SITE DITCH
*RECEPTOR: ON-SITE WORKER (MAINTENANCE AND PLANT AREA B) - CURRENT LAND USE*
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A10-1

22-May-97

NONCARCINOGENIC EFFECTS

| COMPOUND | SEDIMENT CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|
| 1,1,2,2-Tetrachloroethane | 0.003 | 0.99 | 1.7E-11 | 0.11 | 7.7E-11 | 3.0E-02 | 5.8E-10 | 2.6E-09 | 3.2E-09 |
| 1,1-Dichloroethane | 0.0269 | 1.30 | 2.1E-10 | 0.13 | 8.2E-10 | 1.0E-01 | 2.1E-09 | 8.2E-09 | 1.0E-08 |
| 2,4,4-Trimethyl-1-pentene | 2.7831 | 0.99 | 1.6E-08 | 0.11 | 7.1E-08 | 2.1E-01 | 7.9E-08 | 3.5E-07 | 4.3E-07 |
| 2,4,4-Trimethyl-2-Pentene | 0.8529 | 0.99 | 5.0E-09 | 0.11 | 2.2E-08 | 2.1E-01 | 2.4E-08 | 1.1E-07 | 1.3E-07 |
| 2-Butanone (MEK) | 0.074 | 1.00 | 4.3E-10 | 0.10 | 1.7E-09 | 6.0E-01 | 7.2E-10 | 2.9E-09 | 3.6E-09 |
| 2-Hexanone | 0.036 | 1.00 | 2.1E-10 | 0.10 | 8.4E-10 | 6.0E-01 | 3.5E-10 | 1.4E-09 | 1.8E-09 |
| Acetone | 0.1836 | 1.00 | 1.1E-09 | 0.10 | 4.3E-09 | 1.0E-01 | 1.1E-08 | 4.3E-08 | 5.4E-08 |
| Benzene | 0.015 | 1.00 | 8.8E-11 | 0.08 | 2.8E-10 | 5.0E-03 | 1.8E-08 | 5.6E-08 | 7.4E-08 |
| Carbon Disulfide | 0.005 | 1.09 | 3.2E-11 | 0.12 | 1.4E-10 | 1.0E-01 | 3.2E-10 | 1.4E-09 | 1.7E-09 |
| Chlorobenzene | 0.007 | 1.00 | 4.1E-11 | 0.10 | 1.6E-10 | 2.0E-02 | 2.1E-09 | 8.2E-09 | 1.0E-08 |
| Ethylbenzene | 0.0396 | 1.00 | 2.3E-10 | 0.20 | 1.8E-09 | 1.0E-01 | 2.3E-09 | 1.8E-08 | 2.1E-08 |
| Methylene Chloride | 0.024 | 1.00 | 1.4E-10 | 0.10 | 5.6E-10 | 6.0E-02 | 2.3E-09 | 9.3E-09 | 1.2E-08 |
| Styrene | 0.007 | 1.00 | 4.1E-11 | 0.20 | 3.3E-10 | 2.0E-01 | 2.1E-10 | 1.6E-09 | 1.8E-09 |
| Tetrachloroethene (PCE) | 0.0266 | 1.00 | 1.6E-10 | 0.10 | 6.2E-10 | 1.0E-02 | 1.6E-08 | 6.2E-08 | 7.8E-08 |
| Toluene | 0.0719 | 1.00 | 4.2E-10 | 0.12 | 2.0E-09 | 2.0E-01 | 2.1E-09 | 1.0E-08 | 1.2E-08 |
| Xylenes, Total | 0.0366 | 1.00 | 2.1E-10 | 0.12 | 1.0E-09 | 2.0E+00 | 1.1E-10 | 5.1E-10 | 6.2E-10 |
| 1,2,4-Trichlorobenzene | 1.4 | 1.00 | 8.2E-09 | 0.08 | 2.6E-08 | 1.0E-02 | 8.2E-07 | 2.6E-06 | 3.4E-06 |
| 1,2-Dichlorobenzene | 1.6 | 1.00 | 9.4E-09 | 0.10 | 3.7E-08 | 9.0E-02 | 1.0E-07 | 4.2E-07 | 5.2E-07 |
| 2-Methylnaphthalene | 1.4 | 1.00 | 8.2E-09 | 0.20 | 6.5E-08 | 3.0E-02 | 2.7E-07 | 2.2E-06 | 2.5E-06 |
| 4-Bromophenyl-phenylether | 3.4 | | | | | | | | |
| 4-Chlorophenyl-phenylether | 2.3 | | | | | | | | |
| Benzo(a)Anthracene | 2.1 | 0.91 | 1.1E-08 | 0.18 | 8.8E-08 | 3.0E-02 | 3.7E-07 | 2.9E-06 | 3.3E-06 |
| Benzo(a)Pyrene | 0.1 | 0.91 | 5.3E-10 | 0.18 | 4.2E-09 | 3.0E-02 | 1.8E-08 | 1.4E-07 | 1.6E-07 |
| Benzo(b)Fluoranthene | 0.87 | 0.91 | 4.6E-09 | 0.18 | 3.7E-08 | 3.0E-02 | 1.5E-07 | 1.2E-06 | 1.4E-06 |
| Benzo(g,h,i)Perylene | 0.083 | 0.91 | 4.4E-10 | 0.18 | 3.5E-09 | 3.0E-02 | 1.5E-08 | 1.2E-07 | 1.3E-07 |
| Benzoic Acid | 2 | 0.96 | 1.1E-08 | 0.18 | 8.4E-08 | 4.0E+00 | 2.8E-09 | 2.1E-08 | 2.4E-08 |
| Butylbenzylphthalate | 57.6357 | 0.96 | 3.2E-07 | 0.18 | 2.4E-06 | 2.0E-01 | 1.6E-06 | 1.2E-05 | 1.4E-05 |
| Chrysene | 1.3 | 0.91 | 6.9E-09 | 0.18 | 5.5E-08 | 3.0E-02 | 2.3E-07 | 1.8E-06 | 2.1E-06 |
| Di-n-butylphthalate | 154.8332 | 0.96 | 8.7E-07 | 0.18 | 6.5E-06 | 1.0E-01 | 8.7E-06 | 6.5E-05 | 7.3E-05 |
| Di-n-octylphthalate | 24 | 0.96 | 1.3E-07 | 0.18 | 1.0E-06 | 2.0E-02 | 6.7E-06 | 5.0E-05 | 5.7E-05 |
| Dibenzofuran | 5.9 | 1.00 | 3.5E-08 | 0.19 | 2.6E-07 | 3.0E-02 | 1.2E-06 | 8.6E-06 | 9.7E-06 |
| Dimethylphthalate | 0.53 | 1.00 | 3.1E-09 | 0.07 | 8.7E-09 | 1.0E+00 | 3.1E-09 | 8.7E-09 | 1.2E-08 |
| Fluoranthene | 4.1 | 1.00 | 2.4E-08 | 0.20 | 1.9E-07 | 4.0E-02 | 6.0E-07 | 4.8E-06 | 5.4E-06 |
| Fluorene | 4 | 1.00 | 2.3E-08 | 0.20 | 1.9E-07 | 4.0E-02 | 5.9E-07 | 4.7E-06 | 5.3E-06 |
| Indeno (1,2,3-cd)Pyrene | 13 | 0.91 | 6.9E-08 | 0.18 | 5.5E-07 | 3.0E-02 | 2.3E-06 | 1.8E-05 | 2.1E-05 |
| N-Nitrosodiphenylamine | 422.6209 | 0.96 | 2.4E-06 | 0.18 | 1.8E-05 | 5.0E-02 | 4.8E-05 | 3.5E-04 | 4.0E-04 |
| Naphthalene | 2.2 | 1.00 | 1.3E-08 | 0.10 | 5.1E-08 | 4.0E-02 | 3.2E-07 | 1.3E-06 | 1.6E-06 |
| Phenanthrene | 34 | 0.91 | 1.8E-07 | 0.18 | 1.4E-06 | 3.0E-02 | 6.1E-06 | 4.8E-05 | 5.4E-05 |
| Phenol | 31.0897 | 1.00 | 1.8E-07 | 0.26 | 1.9E-06 | 6.0E-01 | 3.0E-07 | 3.1E-06 | 3.5E-06 |
| Pyrene | 9.1 | 1.00 | 5.3E-08 | 0.20 | 4.3E-07 | 3.0E-02 | 1.8E-06 | 1.4E-05 | 1.6E-05 |

[1] MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
ND = no data available

MWSDIDOD
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SEDIMENT - ON-SITE DITCH
RECEPTOR: ON-SITE WORKER (MAINTENANCE AND PLANT AREA B) - CURRENT LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A10-1

22-May-97
NONCARCINOGENIC EFFECTS (CONTINUED)

| COMPOUND | SEDIMENT CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|
| bis(2-EthylHexyl)phthalate | 11092.8642 | 1.00 | 6.5E-05 | 0.02 | 5.2E-05 | 2.0E-02 | 3.3E-03 | 2.6E-03 | 5.8E-03 |
| 4,4'-DDT | 0.0958 | 0.96 | 5.4E-10 | 0.18 | 4.0E-09 | 5.0E-04 | 1.1E-06 | 8.0E-06 | 9.1E-06 |
| Aldrin | 0.0469 | 1.00 | 2.8E-10 | 0.25 | 2.7E-09 | 3.0E-05 | 9.2E-06 | 9.1E-05 | 1.0E-04 |
| Alpha-Chlordane | 0.025 | 1.00 | 1.5E-10 | 0.05 | 2.9E-10 | 6.0E-05 | 2.4E-06 | 4.9E-06 | 7.3E-06 |
| Beta-BHC | 0.0438 | 0.96 | 2.5E-10 | 0.18 | 1.8E-09 | 5.0E-04 | 4.9E-07 | 3.7E-06 | 4.2E-06 |
| Endosulfan I | 0.0409 | 0.96 | 2.3E-10 | 0.18 | 1.7E-09 | 6.0E-03 | 3.8E-08 | 2.8E-07 | 3.2E-07 |
| Endosulfan Sulfate | 0.0693 | 0.96 | 3.9E-10 | 0.18 | 2.9E-09 | 6.0E-03 | 6.5E-08 | 4.8E-07 | 5.5E-07 |
| Endrin | 0.035 | 1.00 | 2.1E-10 | 0.25 | 2.0E-09 | 3.0E-04 | 6.8E-07 | 6.8E-06 | 7.5E-06 |
| Endrin Aldehyde | 0.1578 | 0.96 | 8.9E-10 | 0.18 | 6.6E-09 | 3.0E-04 | 3.0E-06 | 2.2E-05 | 2.5E-05 |
| Endrin Ketone | 0.0641 | 0.96 | 3.6E-10 | 0.18 | 2.7E-09 | 3.0E-04 | 1.2E-06 | 8.9E-06 | 1.0E-05 |
| Heptachlor | 0.0441 | 1.00 | 2.6E-10 | 0.20 | 2.1E-09 | 5.0E-04 | 5.2E-07 | 4.1E-06 | 4.6E-06 |
| Heptachlor Epoxide | 0.006 | 1.00 | 3.5E-11 | 0.20 | 2.8E-10 | 1.3E-05 | 2.7E-06 | 2.2E-05 | 2.4E-05 |
| Methoxychlor | 0.29 | 1.00 | 1.7E-09 | 0.20 | 1.4E-08 | 5.0E-03 | 3.4E-07 | 2.7E-06 | 3.0E-06 |
| Aluminum | 7444.4828 | | | | | | | | |
| Antimony | 20.7966 | 1.00 | 1.2E-07 | 0.10 | 4.9E-07 | 4.0E-04 | 3.1E-04 | 1.2E-03 | 1.5E-03 |
| Arsenic | 4.7845 | 1.00 | 2.8E-08 | 0.03 | 3.4E-08 | 3.0E-04 | 9.4E-05 | 1.1E-04 | 2.1E-04 |
| Barium | 19.131 | 0.71 | 8.0E-08 | 0.05 | 2.4E-07 | 7.0E-02 | 1.1E-06 | 3.5E-06 | 4.6E-06 |
| Beryllium | 1.0353 | 1.00 | 6.1E-09 | 0.03 | 7.3E-09 | 5.0E-03 | 1.2E-06 | 1.5E-06 | 2.7E-06 |
| Cadmium | 0.6029 | 1.00 | 3.5E-09 | 0.14 | 2.0E-08 | 5.0E-04 | 7.1E-06 | 3.9E-05 | 4.7E-05 |
| Calcium | 1191.6552 | | | | | | | | |
| Chromium III | 1244.7 | 1.00 | 7.3E-06 | 0.04 | 1.2E-05 | 1.0E+00 | 7.3E-06 | 1.2E-05 | 1.9E-05 |
| Cobalt | 5.3172 | 1.86 | 5.8E-08 | 0.14 | 1.8E-07 | 1.8E-01 | 3.2E-07 | 9.9E-07 | 1.3E-06 |
| Copper | 13.5328 | | | | | | | | |
| Iron | 7623.1035 | | | | | | | | |
| Lead | 13.6179 | 0.50 | 4.0E-08 | 0.01 | 1.9E-08 | 7.5E-04 | 5.3E-05 | 2.5E-05 | 7.9E-05 |
| Manganese | 41.4862 | 1.86 | 4.5E-07 | 0.14 | 1.4E-06 | 4.7E-02 | 9.6E-06 | 2.9E-05 | 3.9E-05 |
| Mercury | 0.2198 | 1.00 | 1.3E-09 | 0.05 | 2.6E-09 | 3.0E-04 | 4.3E-06 | 8.6E-06 | 1.3E-05 |
| Nickel | 10.6535 | 1.00 | 6.3E-08 | 0.35 | 8.7E-07 | 2.0E-02 | 3.1E-06 | 4.4E-05 | 4.7E-05 |
| Potassium | 306.6552 | | | | | | | | |
| Selenium | 0.3928 | 1.00 | 2.3E-09 | 0.00 | 1.8E-10 | 5.0E-03 | 4.6E-07 | 3.7E-08 | 5.0E-07 |
| Silver | 1.0288 | 1.00 | 6.0E-09 | 0.25 | 6.0E-08 | 5.0E-03 | 1.2E-06 | 1.2E-05 | 1.3E-05 |
| Sodium | 184.1379 | | | | | | | | |
| Vanadium | 12.8931 | 0.71 | 5.4E-08 | 0.05 | 1.6E-07 | 7.0E-03 | 7.7E-06 | 2.3E-05 | 3.1E-05 |
| Zinc | 43.5535 | 1.00 | 2.6E-07 | 0.02 | 2.0E-07 | 3.0E-01 | 8.5E-07 | 6.8E-07 | 1.5E-06 |
| Chloride | 75 | | | | | | | | |
| Nitrate as N | 3.25 | 0.71 | 1.4E-08 | 0.05 | 4.1E-08 | 1.6E+00 | 8.5E-09 | 2.6E-08 | 3.4E-08 |
| Nitrite as N | 1.35 | 0.71 | 5.6E-09 | 0.05 | 1.7E-08 | 1.0E-01 | 5.6E-08 | 1.7E-07 | 2.3E-07 |
| Nitrogen, Ammonia | 117 | 0.71 | 4.9E-07 | 0.05 | 1.5E-06 | 3.7E-01 | 1.3E-06 | 4.0E-06 | 5.3E-06 |
| Sulfate as SO4 | 553.3044 | | | | | | | | |
| Chromium VI | 138.3 | 1.00 | 8.1E-07 | 0.09 | 2.9E-06 | 5.0E-03 | 1.6E-04 | 5.8E-04 | 7.4E-04 |
| | | | | | SUMMARY HAZARD INDEX | | 4E-03 | 5E-03 | 9E-03 |

[1] MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
ND = no data available

TRSDIDED
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SEDIMENT - EAST DITCH
RECEPTOR: NEIGHBORHOOD RESIDENT (AGES 7 THROUGH 16) - CURRENT LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A10-2

22-May-97

EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| CONCENTRATION SEDIMENT | $[OHM]_{sediment}$ | chemical specific | chemical-specific | |
| INGESTION RATE | IR | 50 | mg-sediment/day | MADEP, 1995 |
| ADHERENCE FACTOR | AF | 0.51 | mg-sediment/cm^2-skin | MADEP, 1995 |
| AVERAGE SURFACE AREA (1) | SA | 4,521 | $cm^2$/day | calculated per MADEP, 1995 |
| RELATIVE ABSORPTION FACTOR-ORAL | RAF-O | chemical specific | unitless | MADEP, 1994, 1995 |
| RELATIVE ABSORPTION FACTOR -DERM | RAF-D | chemical specific | unitless | MADEP, 1994, 1995 |
| CONVERSION FACTOR | CF | 1.00E-06 | kg/mg | |
| BODY WEIGHT (2) | BW | 42 | kg | calculated per MADEP, 1995 |
| EXPOSURE PERIOD | EP | 10 | years | Assumption |
| EXPOSURE FREQUENCY (3) | EF | 6 | events/year | Assumption |
| EXPOSURE DURATION | ED | 1 | day/event | Assumption |
| AVERAGING PERIOD | | | | |
| CANCER | AP | 75 | years | *MADEP, 1995* |
| NONCANCER | AP | 10 | years | Assumption |

(1) 50th percentile of surface areas for males aged 7 through 16 years: head, hands, forearms, lower legs.
(2) 50th percentile of body weights for males aged 7 through 16 years.
(3) 2 events per month, June through August.
MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
MADEP, 1995. *Guidance for Disposal Site Risk Characterization. Interim Final Policy WSC/ORS-95-141. July 1995.*

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)^-1

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE-INGESTION} = \frac{[OHM]sediment \times IR \times RAF\text{-}O \times CF \times EF \times ED \times EP}{BW \times AP \times 365\ days/yr}$$

$$\text{INTAKE-DERMAL} = \frac{[OHM]sediment \times SA \times AF \times RAF\text{-}D \times EF \times ED \times EP \times CF}{BW \times AP \times 365\ days/yr}$$

TRSDIDED
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SEDIMENT - EAST DITCH
RECEPTOR: NEIGHBORHOOD RESIDENT (AGES 7 THROUGH 16) - CURRENT LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A10-2

22-May-97

CARCINOGENIC EFFECTS

| COMPOUND | SEDIMENT CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | CANCER SLOPE FACTOR (mg/kg-day)^-1 | CANCER RISK INGESTION | CANCER RISK DERMAL | TOTAL CANCER RISK |
|---|---|---|---|---|---|---|---|---|---|
| 1,1,2,2-Tetrachloroethane | 0.0073 | 1.00 | 1.9E-11 | 1.40 | 1.2E-09 | 2.0E-01 | 3.8E-12 | 2.5E-10 | 2.5E-10 |
| 1,1-Dichloroethane | 0.0083 | 0.99 | 2.1E-11 | 0.11 | 1.1E-10 | 5.7E-03 | 1.2E-13 | 6.3E-13 | 7.5E-13 |
| 1,2-Dichloropropane | 0.0086 | 1.00 | 2.2E-11 | 0.20 | 2.1E-10 | 6.8E-02 | 1.5E-12 | 1.4E-11 | 1.6E-11 |
| Benzene | 0.0087 | 1.00 | 2.3E-11 | 0.08 | 8.4E-11 | 2.9E-02 | 6.6E-13 | 2.4E-12 | 3.1E-12 |
| Methylene Chloride | 0.008 | 1.00 | 2.1E-11 | 0.10 | 9.6E-11 | 7.5E-03 | 1.6E-13 | 7.2E-13 | 8.8E-13 |
| Tetrachloroethene (PCE) | 0.0075 | 1.00 | 2.0E-11 | 0.10 | 9.0E-11 | 5.1E-02 | 1.0E-12 | 4.6E-12 | 5.6E-12 |
| Trichloroethene (TCE) | 0.0199 | 1.00 | 5.2E-11 | 0.10 | 2.4E-10 | 1.5E-02 | 7.8E-13 | 3.6E-12 | 4.4E-12 |
| Vinyl Chloride | 0.012 | 1.53 | 4.8E-11 | 0.16 | 2.3E-10 | 1.9E+00 | 9.1E-11 | 4.4E-10 | 5.3E-10 |
| Benzo(a)Anthracene | 0.5473 | 1.00 | 1.4E-09 | 0.20 | 1.3E-08 | 7.3E-01 | 1.0E-09 | 9.6E-09 | 1.1E-08 |
| Benzo(a)Pyrene | 0.5701 | 1.00 | 1.5E-09 | 0.20 | 1.4E-08 | 7.3E+00 | 1.1E-08 | 1.0E-07 | 1.1E-07 |
| Benzo(b)Fluoranthene | 1.0074 | 1.00 | 2.6E-09 | 0.20 | 2.4E-08 | 7.3E-01 | 1.9E-09 | 1.8E-08 | 2.0E-08 |
| Benzo(k)Fluoranthene | 0.4046 | 1.00 | 1.1E-09 | 0.20 | 9.7E-09 | 7.3E-02 | 7.7E-11 | 7.1E-10 | 7.9E-10 |
| Butylbenzylphthalate | 0.4541 | | | | | ND | | | |
| Chrysene | 0.9084 | 1.00 | 2.4E-09 | 0.20 | 2.2E-08 | 7.3E-03 | 1.7E-11 | 1.6E-10 | 1.8E-10 |
| Dibenzo(a,h)Anthracene | 0.43 | 1.00 | 1.1E-09 | 0.09 | 4.7E-09 | 7.3E+00 | 8.2E-09 | 3.4E-08 | 4.2E-08 |
| Indeno (1,2,3-cd)Pyrene | 0.5697 | 1.00 | 1.5E-09 | 0.20 | 1.4E-08 | 7.3E-01 | 1.1E-09 | 1.0E-08 | 1.1E-08 |
| N-Nitrosodiphenylamine | 1.0529 | 0.91 | 2.5E-09 | 0.17 | 2.2E-08 | 4.9E-03 | 1.2E-11 | 1.1E-10 | 1.2E-10 |
| bis(2-EthylHexyl)phthalate | 756.6347 | 1.00 | 2.0E-06 | 0.02 | 1.8E-06 | 1.4E-02 | 2.8E-08 | 2.5E-08 | 5.3E-08 |
| 4,4'-DDD | 0.007 | 1.00 | 1.8E-11 | 0.20 | 1.7E-10 | 2.4E-01 | 4.4E-12 | 4.0E-11 | 4.5E-11 |
| 4,4'-DDT | 0.026 | 1.00 | 6.8E-11 | 0.20 | 6.3E-10 | 3.4E-01 | 2.3E-11 | 2.1E-10 | 2.4E-10 |
| Alpha-Chlordane | 0.4851 | 1.00 | 1.3E-09 | 0.05 | 2.9E-09 | 1.3E+00 | 1.6E-09 | 3.8E-09 | 5.4E-09 |
| Gamma-Chlordane | 0.4623 | 1.00 | 1.2E-09 | 0.05 | 2.8E-09 | 1.3E+00 | 1.6E-09 | 3.6E-09 | 5.2E-09 |
| Arsenic | 104.2066 | 1.00 | 2.7E-07 | 0.03 | 3.8E-07 | 1.5E+00 | 4.1E-07 | 5.6E-07 | 9.7E-07 |
| Cadmium | 2.4706 | | | | | ND | | | |
| Lead | 111.3073 | | | | | ND | | | |
| | | | | | SUMMARY CANCER RISK | | 5E-07 | 6E-07 | 1E-06 |

[1] MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.

TRSDIDED
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SEDIMENT - EAST DITCH
RECEPTOR: NEIGHBORHOOD RESIDENT (AGES 7 THROUGH 16) - CURRENT LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A10-2

22-May-97

NONCARCINOGENIC EFFECTS

| COMPOUND | SEDIMENT CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|
| 1,1,1-Trichloroethane | 2.6181 | 1.00 | 5.1E-08 | 0.10 | 2.4E-07 | 9.0E-01 | 5.7E-08 | 2.6E-07 | 3.2E-07 |
| 1,1,2,2-Tetrachloroethane | 0.0073 | 0.99 | 1.4E-10 | 0.11 | 7.2E-10 | 3.0E-02 | 4.7E-09 | 2.4E-08 | 2.9E-08 |
| 1,1-Dichloroethane | 0.0083 | 1.30 | 2.1E-10 | 0.13 | 9.7E-10 | 1.0E-01 | 2.1E-09 | 9.7E-09 | 1.2E-08 |
| 1,2-Dichloroethene(total) | 0.0153 | 1.00 | 3.0E-10 | 0.10 | 1.4E-09 | 9.0E-03 | 3.3E-08 | 1.5E-07 | 1.9E-07 |
| 1,2-Dichloropropane | 0.0086 | 0.99 | 1.7E-10 | 0.11 | 8.5E-10 | 6.2E-01 | 2.7E-10 | 1.4E-09 | 1.6E-09 |
| 2,4,4-Trimethyl-1-pentene | 0.0541 | 0.99 | 1.0E-09 | 0.11 | 5.4E-09 | 2.1E-01 | 5.1E-09 | 2.6E-08 | 3.1E-08 |
| 2,4,4-Trimethyl-2-Pentene | 0.0804 | 0.99 | 1.6E-09 | 0.11 | 8.0E-09 | 2.1E-01 | 7.6E-09 | 3.9E-08 | 4.7E-08 |
| 2-Butanone (MEK) | 0.0371 | 1.00 | 7.3E-10 | 0.10 | 3.3E-09 | 6.0E-01 | 1.2E-09 | 5.6E-09 | 6.8E-09 |
| Acetone | 0.2288 | 1.00 | 4.5E-09 | 0.10 | 2.1E-08 | 1.0E-01 | 4.5E-08 | 2.1E-07 | 2.5E-07 |
| Benzene | 0.0087 | 1.00 | 1.7E-10 | 0.08 | 6.3E-10 | 5.0E-03 | 3.4E-08 | 1.3E-07 | 1.6E-07 |
| Chlorobenzene | 0.0073 | 1.00 | 1.4E-10 | 0.10 | 6.6E-10 | 2.0E-02 | 7.1E-09 | 3.3E-08 | 4.0E-08 |
| Ethylbenzene | 0.005 | 1.00 | 9.8E-11 | 0.20 | 9.0E-10 | 1.0E-01 | 9.8E-10 | 9.0E-09 | 1.0E-08 |
| Methylene Chloride | 0.008 | 1.00 | 1.6E-10 | 0.10 | 7.2E-10 | 6.0E-02 | 2.6E-09 | 1.2E-08 | 1.5E-08 |
| Styrene | 0.005 | 1.00 | 9.8E-11 | 0.20 | 9.0E-10 | 2.0E-01 | 4.9E-10 | 4.5E-09 | 5.0E-09 |
| Tetrachloroethene (PCE) | 0.0075 | 1.00 | 1.5E-10 | 0.10 | 6.8E-10 | 1.0E-02 | 1.5E-08 | 6.8E-08 | 8.2E-08 |
| Toluene | 0.0069 | 1.00 | 1.4E-10 | 0.12 | 7.5E-10 | 2.0E-01 | 6.8E-10 | 3.7E-09 | 4.4E-09 |
| Trichloroethene (TCE) | 0.0199 | 1.00 | 3.9E-10 | 0.10 | 1.8E-09 | 2.0E-03 | 1.9E-07 | 9.0E-07 | 1.1E-06 |
| Vinyl Chloride | 0.012 | 1.00 | 2.3E-10 | 0.10 | 1.1E-09 | 1.0E-03 | 2.3E-07 | 1.1E-06 | 1.3E-06 |
| Xylenes, Total | 0.0079 | 1.00 | 1.5E-10 | 0.12 | 8.6E-10 | 2.0E+00 | 7.7E-11 | 4.3E-10 | 5.1E-10 |
| 4-Bromophenyl-phenylether | 0.23 | | | | | | | | |
| 4-Chlorophenyl-phenylether | 0.22 | | | | | | | | |
| Anthracene | 0.3312 | 1.00 | 6.5E-09 | 0.29 | 8.7E-08 | 3.0E-01 | 2.2E-08 | 2.9E-07 | 3.1E-07 |
| Benzo(a)Anthracene | 0.5473 | 0.91 | 9.7E-09 | 0.18 | 8.9E-08 | 3.0E-02 | 3.2E-07 | 3.0E-06 | 3.3E-06 |
| Benzo(a)Pyrene | 0.5701 | 0.91 | 1.0E-08 | 0.18 | 9.3E-08 | 3.0E-02 | 3.4E-07 | 3.1E-06 | 3.4E-06 |
| Benzo(b)Fluoranthene | 1.0074 | 0.91 | 1.8E-08 | 0.18 | 1.6E-07 | 3.0E-02 | 6.0E-07 | 5.5E-06 | 6.1E-06 |
| Benzo(g,h,i)Perylene | 0.5962 | 0.91 | 1.1E-08 | 0.18 | 9.7E-08 | 3.0E-02 | 3.5E-07 | 3.2E-06 | 3.6E-06 |
| Benzo(k)Fluoranthene | 0.4046 | 0.91 | 7.2E-09 | 0.18 | 6.6E-08 | 3.0E-02 | 2.4E-07 | 2.2E-06 | 2.4E-06 |
| Benzoic Acid | 1.9047 | 0.96 | 3.6E-08 | 0.18 | 3.1E-07 | 4.0E+00 | 8.9E-09 | 7.7E-08 | 8.6E-08 |
| Butylbenzylphthalate | 0.4541 | 0.96 | 8.5E-09 | 0.18 | 7.3E-08 | 2.0E-01 | 4.3E-08 | 3.7E-07 | 4.1E-07 |
| Chrysene | 0.9084 | 0.91 | 1.6E-08 | 0.18 | 1.5E-07 | 3.0E-02 | 5.4E-07 | 4.9E-06 | 5.5E-06 |
| Di-n-butylphthalate | 0.5 | 0.96 | 9.4E-09 | 0.18 | 8.1E-08 | 1.0E-01 | 9.4E-08 | 8.1E-07 | 9.0E-07 |
| Di-n-octylphthalate | 0.9952 | 0.96 | 1.9E-08 | 0.18 | 1.6E-07 | 2.0E-02 | 9.3E-07 | 8.0E-06 | 9.0E-06 |
| Dibenzo(a,h)Anthracene | 0.43 | 0.91 | 7.7E-09 | 0.08 | 3.1E-08 | 3.0E-02 | 2.6E-07 | 1.0E-06 | 1.3E-06 |
| Dibenzofuran | 0.22 | 1.00 | 4.3E-09 | 0.19 | 3.7E-08 | 3.0E-02 | 1.4E-07 | 1.2E-06 | 1.4E-06 |
| Fluoranthene | 1.3545 | 1.00 | 2.7E-08 | 0.20 | 2.4E-07 | 4.0E-02 | 6.6E-07 | 6.1E-06 | 6.8E-06 |
| Fluorene | 0.4 | 1.00 | 7.8E-09 | 0.20 | 7.2E-08 | 4.0E-02 | 2.0E-07 | 1.8E-06 | 2.0E-06 |
| Indeno (1,2,3-cd)Pyrene | 0.5697 | 0.91 | 1.0E-08 | 0.18 | 9.3E-08 | 3.0E-02 | 3.4E-07 | 3.1E-06 | 3.4E-06 |
| N-Nitrosodiphenylamine | 1.0529 | 0.96 | 2.0E-08 | 0.18 | 1.7E-07 | 5.0E-02 | 3.9E-07 | 3.4E-06 | 3.8E-06 |
| Naphthalene | 3.4113 | 1.00 | 6.7E-08 | 0.10 | 3.1E-07 | 4.0E-02 | 1.7E-06 | 7.7E-06 | 9.4E-06 |
| Phenanthrene | 0.7095 | 0.91 | 1.3E-08 | 0.18 | 1.2E-07 | 3.0E-02 | 4.2E-07 | 3.8E-06 | 4.3E-06 |

[1] MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
ND = no data available

TRSDIDED
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SEDIMENT - EAST DITCH
RECEPTOR: NEIGHBORHOOD RESIDENT (AGES 7 THROUGH 16) - CURRENT LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A10-2

22-May-97
NONCARCINOGENIC EFFECTS (CONTINUED)

| COMPOUND | SEDIMENT CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|
| Phenol | 0.3438 | 1.00 | 6.7E-09 | 0.26 | 8.1E-08 | 6.0E-01 | 1.1E-08 | 1.3E-07 | 1.5E-07 |
| Pyrene | 0.9787 | 1.00 | 1.9E-08 | 0.20 | 1.8E-07 | 3.0E-02 | 6.4E-07 | 5.9E-06 | 6.5E-06 |
| bis(2-EthylHexyl)phthalate | 756.6347 | 1.00 | 1.5E-05 | 0.02 | 1.4E-05 | 2.0E-02 | 7.4E-04 | 6.8E-04 | 1.4E-03 |
| 4,4'-DDD | 0.007 | 0.96 | 1.3E-10 | 0.18 | 1.1E-09 | 5.0E-04 | 2.6E-07 | 2.3E-06 | 2.5E-06 |
| 4,4'-DDT | 0.026 | 0.96 | 4.9E-10 | 0.18 | 4.2E-09 | 5.0E-04 | 9.7E-07 | 8.4E-06 | 9.4E-06 |
| Alpha-Chlordane | 0.4851 | 1.00 | 9.5E-09 | 0.05 | 2.2E-08 | 6.0E-05 | 1.6E-04 | 3.6E-04 | 5.2E-04 |
| Delta-BHC | 0.0487 | 0.96 | 9.1E-10 | 0.18 | 7.9E-09 | 5.0E-04 | 1.8E-06 | 1.6E-05 | 1.8E-05 |
| Endosulfan I | 0.0504 | 0.96 | 9.4E-10 | 0.18 | 8.1E-09 | 6.0E-03 | 1.6E-07 | 1.4E-06 | 1.5E-06 |
| Endosulfan Sulfate | 0.1056 | 0.96 | 2.0E-09 | 0.18 | 1.7E-08 | 6.0E-03 | 3.3E-07 | 2.8E-06 | 3.2E-06 |
| Endrin | 0.1157 | 1.00 | 2.3E-09 | 0.25 | 2.6E-08 | 3.0E-04 | 7.5E-06 | 8.7E-05 | 9.5E-05 |
| Endrin Aldehyde | 0.4189 | 0.96 | 7.9E-09 | 0.18 | 6.8E-08 | 3.0E-04 | 2.6E-05 | 2.3E-04 | 2.5E-04 |
| Endrin Ketone | 0.1059 | 0.96 | 2.0E-09 | 0.18 | 1.7E-08 | 3.0E-04 | 6.6E-06 | 5.7E-05 | 6.4E-05 |
| Gamma-Chlordane | 0.4623 | 1.00 | 9.0E-09 | 0.05 | 2.1E-08 | 6.0E-05 | 1.5E-04 | 3.5E-04 | 5.0E-04 |
| Aluminum | 10639.8111 | | | | | | | | |
| Antimony | 17.6299 | 1.00 | 3.5E-07 | 0.10 | 1.6E-06 | 4.0E-04 | 8.6E-04 | 4.0E-03 | 4.8E-03 |
| Arsenic | 104.2066 | 1.00 | 2.0E-06 | 0.03 | 2.8E-06 | 3.0E-04 | 6.8E-03 | 9.4E-03 | 1.6E-02 |
| Barium | 52.7234 | 0.71 | 7.3E-07 | 0.05 | 2.6E-06 | 7.0E-02 | 1.0E-05 | 3.7E-05 | 4.8E-05 |
| Cadmium | 2.4706 | 1.00 | 4.8E-08 | 0.14 | 3.1E-07 | 5.0E-04 | 9.7E-05 | 6.2E-04 | 7.2E-04 |
| Calcium | 2080.6833 | | | | | | | | |
| Chromium III | 560.7 | 1.00 | 1.1E-05 | 0.04 | 2.0E-05 | 1.0E+00 | 1.1E-05 | 2.0E-05 | 3.1E-05 |
| Cobalt | 10.0505 | 1.86 | 3.7E-07 | 0.14 | 1.3E-06 | 6.0E-02 | 6.1E-06 | 2.2E-05 | 2.8E-05 |
| Copper | 75.3681 | | | | | | | | |
| Iron | 39739.7944 | | | | | | | | |
| Lead | 111.3073 | 0.50 | 1.1E-06 | 0.01 | 6.0E-07 | 7.5E-04 | 1.5E-03 | 8.0E-04 | 2.3E-03 |
| Manganese | 360.9 | 1.86 | 1.3E-05 | 0.14 | 4.7E-05 | 4.7E-02 | 2.8E-04 | 9.9E-04 | 1.3E-03 |
| Mercury | 0.3008 | 1.00 | 5.9E-09 | 0.05 | 1.4E-08 | 3.0E-04 | 2.0E-05 | 4.5E-05 | 6.5E-05 |
| Nickel | 13.5962 | 1.00 | 2.7E-07 | 0.35 | 4.3E-06 | 2.0E-02 | 1.3E-05 | 2.1E-04 | 2.3E-04 |
| Potassium | 647.8189 | | | | | | | | |
| Sodium | 152.8 | | | | | | | | |
| Vanadium | 24.0622 | 0.71 | 3.3E-07 | 0.05 | 1.2E-06 | 7.0E-03 | 4.8E-05 | 1.7E-04 | 2.2E-04 |
| Zinc | 207.7258 | 1.00 | 4.1E-06 | 0.02 | 3.7E-06 | 3.0E-01 | 1.4E-05 | 1.2E-05 | 2.6E-05 |
| Chloride | 58.5663 | | | | | | | | |
| Nitrate as N | 0.0015 | 0.71 | 2.1E-11 | 0.05 | 7.4E-11 | 1.6E+00 | 1.3E-11 | 4.6E-11 | 5.9E-11 |
| Nitrogen, Ammonia | 100.2447 | 0.71 | 1.4E-06 | 0.05 | 4.9E-06 | 3.7E-01 | 3.8E-06 | 1.3E-05 | 1.7E-05 |
| Sulfate as SO4 | 2103.8889 | | | | | | | | |
| Chromium VI | 62.2 | 1.00 | 1.2E-06 | 0.09 | 5.1E-06 | 5.0E-03 | 2.4E-04 | 1.0E-03 | 1.3E-03 |
| | | | | | SUMMARY HAZARD INDEX | | 1E-02 | 2E-02 | 3E-02 |

[1] MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
ND = no data available

TRSDIDWD
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SEDIMENT - WEST DITCH
RECEPTOR: NEIGHBORHOOD RESIDENT (AGES 7 THROUGH 16) - CURRENT LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A10-3

22-May-97

*EXPOSURE PARAMETERS*

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| CONCENTRATION SEDIMENT | $[OHM]_{sediment}$ | chemical specific | chemical-specific | |
| INGESTION RATE | IR | 50 | mg-sediment/day | MADEP, 1995 |
| ADHERENCE FACTOR | AF | 0.51 | mg-sediment/cm²-skin | MADEP, 1995 |
| AVERAGE SURFACE AREA (1) | SA | 4,521 | cm²/day | calculated per MADEP, 1995 |
| RELATIVE ABSORPTION FACTOR-ORAL | RAF-O | chemical specific | unitless | MADEP, 1994, 1995 |
| RELATIVE ABSORPTION FACTOR -DERM | RAF-D | chemical specific | unitless | MADEP, 1994, 1995 |
| CONVERSION FACTOR | CF | 1.00E-06 | kg/mg | |
| BODY WEIGHT (2) | BW | 42 | kg | calculated per MADEP, 1995 |
| EXPOSURE PERIOD | EP | 10 | years | Assumption |
| EXPOSURE FREQUENCY (3) | EF | 6 | events/year | Assumption |
| EXPOSURE DURATION | ED | 1 | day/event | Assumption |
| AVERAGING PERIOD | | | | |
| CANCER | AP | 75 | years | MADEP, 1995 |
| NONCANCER | AP | 10 | years | Assumption |

(1) 50th percentile of surface areas for males aged 7 through 16 years: head, hands, forearms, lower legs.
(2) 50th percentile of body weights for males aged 7 through 16 years.
(3) 2 events per month, June through August.
MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
MADEP, 1995. Guidance for Disposal Site Risk Characterization. Interim Final Policy WSC/ORS-95-141. July 1995.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)^-1

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE-INGESTION} = \frac{[OHM]sediment \times IR \times RAF\text{-}O \times CF \times EF \times ED \times EP}{BW \times AP \times 365\ days/yr}$$

$$\text{INTAKE-DERMAL} = \frac{[OHM]sediment \times SA \times AF \times RAF\text{-}D \times EF \times ED \times EP \times CF}{BW \times AP \times 365\ days/yr}$$

TRSDIDWD
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SEDIMENT - WEST DITCH
RECEPTOR: NEIGHBORHOOD RESIDENT (AGES 7 THROUGH 16) - CURRENT LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A10-3

22-May-97

CARCINOGENIC EFFECTS

| COMPOUND | SEDIMENT CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | CANCER SLOPE FACTOR (mg/kg-day)^-1 | CANCER RISK INGESTION | CANCER RISK DERMAL | TOTAL CANCER RISK |
|---|---|---|---|---|---|---|---|---|---|
| 1,1-Dichloroethane | 0.004 | 0.99 | 1.0E-11 | 0.11 | 5.3E-11 | 5.7E-03 | 5.9E-14 | 3.0E-13 | 3.6E-13 |
| Bromoform | 0.0265 | 1.00 | 6.9E-11 | 0.10 | 3.2E-10 | 7.9E-03 | 5.5E-13 | 2.5E-12 | 3.1E-12 |
| Carbon Tetrachloride | 0.0052 | 1.00 | 1.4E-11 | 0.10 | 6.3E-11 | 1.3E-01 | 1.8E-12 | 8.1E-12 | 9.9E-12 |
| Chloroform | 0.0048 | 1.00 | 1.3E-11 | 0.10 | 5.8E-11 | 6.1E-03 | 7.6E-14 | 3.5E-13 | 4.3E-13 |
| Dibromochloromethane | 0.0094 | 1.00 | 2.5E-11 | 0.10 | 1.1E-10 | 8.4E-02 | 2.1E-12 | 9.5E-12 | 1.2E-11 |
| Methylene Chloride | 0.0097 | 1.00 | 2.5E-11 | 0.10 | 1.2E-10 | 7.5E-03 | 1.9E-13 | 8.8E-13 | 1.1E-12 |
| Tetrachloroethene (PCE) | 0.004 | 1.00 | 1.0E-11 | 0.10 | 4.8E-11 | 5.1E-02 | 5.3E-13 | 2.5E-12 | 3.0E-12 |
| Trichloroethene (TCE) | 0.003 | 1.00 | 7.8E-12 | 0.10 | 3.6E-11 | 1.5E-02 | 1.2E-13 | 5.4E-13 | 6.6E-13 |
| Benzo(a)Anthracene | 0.2933 | 1.00 | 7.7E-10 | 0.20 | 7.1E-09 | 7.3E-01 | 5.6E-10 | 5.2E-09 | 5.7E-09 |
| Benzo(a)Pyrene | 0.3317 | 1.00 | 8.7E-10 | 0.20 | 8.0E-09 | 7.3E+00 | 6.3E-09 | 5.8E-08 | 6.5E-08 |
| Benzo(b)Fluoranthene | 0.4868 | 1.00 | 1.3E-09 | 0.20 | 1.2E-08 | 7.3E-01 | 9.3E-10 | 8.6E-09 | 9.5E-09 |
| Benzo(k)Fluoranthene | 0.2726 | 1.00 | 7.1E-10 | 0.20 | 6.6E-09 | 7.3E-02 | 5.2E-11 | 4.8E-10 | 5.3E-10 |
| Chrysene | 0.3806 | 1.00 | 9.9E-10 | 0.20 | 9.2E-09 | 7.3E-03 | 7.2E-12 | 6.7E-11 | 7.4E-11 |
| Dibenzo(a,h)Anthracene | 0.12 | 1.00 | 3.1E-10 | 0.09 | 1.3E-09 | 7.3E+00 | 2.3E-09 | 9.5E-09 | 1.2E-08 |
| Indeno (1,2,3-cd)Pyrene | 0.3161 | 1.00 | 8.2E-10 | 0.20 | 7.6E-09 | 7.3E-01 | 6.0E-10 | 5.6E-09 | 6.2E-09 |
| N-Nitrosodiphenylamine | 0.3983 | 0.91 | 9.5E-10 | 0.17 | 8.1E-09 | 4.9E-03 | 4.6E-12 | 4.0E-11 | 4.5E-11 |
| bis(2-EthylHexyl)phthalate | 1.2322 | 1.00 | 3.2E-09 | 0.02 | 3.0E-09 | 1.4E-02 | 4.5E-11 | 4.2E-11 | 8.7E-11 |
| 4,4'-DDD | 0.0296 | 1.00 | 7.7E-11 | 0.20 | 7.1E-10 | 2.4E-01 | 1.9E-11 | 1.7E-10 | 1.9E-10 |
| Alpha-BHC | 0.0052 | 0.96 | 1.3E-11 | 0.18 | 1.1E-10 | 6.3E+00 | 8.2E-11 | 7.1E-10 | 7.9E-10 |
| Beta-BHC | 0.032 | 0.96 | 8.0E-11 | 0.18 | 6.9E-10 | 1.8E+00 | 1.4E-10 | 1.2E-09 | 1.4E-09 |
| Heptachlor Epoxide | 0.0275 | 1.00 | 7.2E-11 | 0.20 | 6.6E-10 | 9.1E+00 | 6.5E-10 | 6.0E-09 | 6.7E-09 |
| Arsenic | 6.1833 | 1.00 | 1.6E-08 | 0.03 | 2.2E-08 | 1.5E+00 | 2.4E-08 | 3.3E-08 | 5.8E-08 |
| Beryllium | 1.0438 | 1.00 | 2.7E-09 | 0.03 | 3.8E-09 | 4.3E+00 | 1.2E-08 | 1.6E-08 | 2.8E-08 |
| Cadmium | 0.8 | | | | | ND | | | |
| Lead | 21.875 | | | | | ND | | | |
| | | | | | SUMMARY CANCER RISK | | 5E-08 | 1E-07 | 2E-07 |

[1] MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.

TRSDIDWD
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SEDIMENT - WEST DITCH
RECEPTOR: NEIGHBORHOOD RESIDENT (AGES 7 THROUGH 16) - CURRENT LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A10-3

22-May-97

NONCARCINOGENIC EFFECTS

| COMPOUND | SEDIMENT CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|
| 1,1,1-Trichloroethane | 0.0074 | 1.00 | 1.4E-10 | 0.10 | 6.7E-10 | 9.0E-01 | 1.6E-10 | 7.4E-10 | 9.0E-10 |
| 1,1-Dichloroethane | 0.004 | 1.30 | 1.0E-10 | 0.13 | 4.7E-10 | 1.0E-01 | 1.0E-09 | 4.7E-09 | 5.7E-09 |
| 2,4,4-Trimethyl-1-pentene | 0.9176 | 0.99 | 1.8E-08 | 0.11 | 9.1E-08 | 2.1E-01 | 8.7E-08 | 4.4E-07 | 5.3E-07 |
| 2,4,4-Trimethyl-2-Pentene | 0.2589 | 0.99 | 5.0E-09 | 0.11 | 2.6E-08 | 2.1E-01 | 2.4E-08 | 1.3E-07 | 1.5E-07 |
| Acetone | 0.0301 | 1.00 | 5.9E-10 | 0.10 | 2.7E-09 | 1.0E-01 | 5.9E-09 | 2.7E-08 | 3.3E-08 |
| Bromoform | 0.0265 | 1.00 | 5.2E-10 | 0.11 | 2.6E-09 | 2.0E-02 | 2.6E-08 | 1.3E-07 | 1.6E-07 |
| Carbon Tetrachloride | 0.0052 | 1.00 | 1.0E-10 | 0.10 | 4.7E-10 | 7.0E-04 | 1.5E-07 | 6.7E-07 | 8.2E-07 |
| Chloroform | 0.0048 | 1.00 | 9.4E-11 | 0.10 | 4.3E-10 | 1.0E-02 | 9.4E-09 | 4.3E-08 | 5.3E-08 |
| Dibromochloromethane | 0.0094 | 1.00 | 1.8E-10 | 0.10 | 8.5E-10 | 2.0E-02 | 9.2E-09 | 4.2E-08 | 5.2E-08 |
| Methylene Chloride | 0.0097 | 1.00 | 1.9E-10 | 0.10 | 8.8E-10 | 6.0E-02 | 3.2E-09 | 1.5E-08 | 1.8E-08 |
| Tetrachloroethene (PCE) | 0.004 | 1.00 | 7.8E-11 | 0.10 | 3.6E-10 | 1.0E-02 | 7.8E-09 | 3.6E-08 | 4.4E-08 |
| Toluene | 0.0066 | 1.00 | 1.3E-10 | 0.12 | 7.1E-10 | 2.0E-01 | 6.5E-10 | 3.6E-09 | 4.2E-09 |
| Trichloroethene (TCE) | 0.003 | 1.00 | 5.9E-11 | 0.10 | 2.7E-10 | 2.0E-03 | 2.9E-08 | 1.4E-07 | 1.6E-07 |
| Xylenes, Total | 0.005 | 1.00 | 9.8E-11 | 0.12 | 5.4E-10 | 2.0E+00 | 4.9E-11 | 2.7E-10 | 3.2E-10 |
| 1,2,4-Trichlorobenzene | 0.21 | 1.00 | 4.1E-09 | 0.08 | 1.5E-08 | 1.0E-02 | 4.1E-07 | 1.5E-06 | 1.9E-06 |
| 4-Bromophenyl-phenylether | 0.3878 | | | | | | | | |
| 4-Chlorophenyl-phenylether | 0.1 | | | | | | | | |
| Benzo(a)Anthracene | 0.2933 | 0.91 | 5.2E-09 | 0.18 | 4.8E-08 | 3.0E-02 | 1.7E-07 | 1.6E-06 | 1.8E-06 |
| Benzo(a)Pyrene | 0.3317 | 0.91 | 5.9E-09 | 0.18 | 5.4E-08 | 3.0E-02 | 2.0E-07 | 1.8E-06 | 2.0E-06 |
| Benzo(b)Fluoranthene | 0.4868 | 0.91 | 8.7E-09 | 0.18 | 7.9E-08 | 3.0E-02 | 2.9E-07 | 2.6E-06 | 2.9E-06 |
| Benzo(g,h,i)Perylene | 0.3111 | 0.91 | 5.6E-09 | 0.18 | 5.1E-08 | 3.0E-02 | 1.8E-07 | 1.7E-06 | 1.9E-06 |
| Benzo(k)Fluoranthene | 0.2726 | 0.91 | 4.9E-09 | 0.18 | 4.4E-08 | 3.0E-02 | 1.6E-07 | 1.5E-06 | 1.6E-06 |
| Benzoic Acid | 0.17 | 0.96 | 3.2E-09 | 0.18 | 2.7E-08 | 4.0E+00 | 8.0E-10 | 6.9E-09 | 7.7E-09 |
| Chrysene | 0.3806 | 0.91 | 6.8E-09 | 0.18 | 6.2E-08 | 3.0E-02 | 2.3E-07 | 2.1E-06 | 2.3E-06 |
| Di-n-butylphthalate | 0.086 | 0.96 | 1.6E-09 | 0.18 | 1.4E-08 | 1.0E-01 | 1.6E-08 | 1.4E-07 | 1.6E-07 |
| Dibenzo(a,h)Anthracene | 0.12 | 0.91 | 2.1E-09 | 0.08 | 8.7E-09 | 3.0E-02 | 7.1E-08 | 2.9E-07 | 3.6E-07 |
| Fluoranthene | 0.7063 | 1.00 | 1.4E-08 | 0.20 | 1.3E-07 | 4.0E-02 | 3.5E-07 | 3.2E-06 | 3.5E-06 |
| Indeno (1,2,3-cd)Pyrene | 0.3161 | 0.91 | 5.6E-09 | 0.18 | 5.1E-08 | 3.0E-02 | 1.9E-07 | 1.7E-06 | 1.9E-06 |
| N-Nitrosodiphenylamine | 0.3983 | 0.96 | 7.5E-09 | 0.18 | 6.4E-08 | 5.0E-02 | 1.5E-07 | 1.3E-06 | 1.4E-06 |
| Phenanthrene | 0.2989 | 0.91 | 5.3E-09 | 0.18 | 4.9E-08 | 3.0E-02 | 1.8E-07 | 1.6E-06 | 1.8E-06 |
| Pyrene | 0.4541 | 1.00 | 8.9E-09 | 0.20 | 8.2E-08 | 3.0E-02 | 3.0E-07 | 2.7E-06 | 3.0E-06 |
| bis(2-EthylHexyl)phthalate | 1.2322 | 1.00 | 2.4E-08 | 0.02 | 2.2E-08 | 2.0E-02 | 1.2E-06 | 1.1E-06 | 2.3E-06 |
| 4,4'-DDD | 0.0296 | 0.96 | 5.5E-10 | 0.18 | 4.8E-09 | 5.0E-04 | 1.1E-06 | 9.6E-06 | 1.1E-05 |
| Alpha-BHC | 0.0052 | 0.96 | 9.7E-11 | 0.18 | 8.4E-10 | 5.0E-04 | 1.9E-07 | 1.7E-06 | 1.9E-06 |
| Beta-BHC | 0.032 | 0.96 | 6.0E-10 | 0.18 | 5.2E-09 | 5.0E-04 | 1.2E-06 | 1.0E-05 | 1.2E-05 |
| Delta-BHC | 0.0263 | 0.96 | 4.9E-10 | 0.18 | 4.2E-09 | 5.0E-04 | 9.9E-07 | 8.5E-06 | 9.5E-06 |
| Endosulfan I | 0.0241 | 0.96 | 4.5E-10 | 0.18 | 3.9E-09 | 6.0E-03 | 7.5E-08 | 6.5E-07 | 7.2E-07 |
| Endosulfan Sulfate | 0.0406 | 0.96 | 7.6E-10 | 0.18 | 6.6E-09 | 6.0E-03 | 1.3E-07 | 1.1E-06 | 1.2E-06 |
| Endrin Aldehyde | 0.012 | 0.96 | 2.2E-10 | 0.18 | 1.9E-09 | 3.0E-04 | 7.5E-07 | 6.5E-06 | 7.2E-06 |
| Heptachlor Epoxide | 0.0275 | 1.00 | 5.4E-10 | 0.20 | 5.0E-09 | 1.3E-05 | 4.1E-05 | 3.8E-04 | 4.2E-04 |

[1] MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
ND = no data available

TRSDIDWD
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SEDIMENT - WEST DITCH
RECEPTOR: *NEIGHBORHOOD RESIDENT (AGES 7 THROUGH 16) - CURRENT LAND USE*
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A10-3

23-May-97
NONCARCINOGENIC EFFECTS (CONTINUED)

| COMPOUND | SEDIMENT CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | REFERENCE DOSE (mg/kg-day) | HAZARD QUOTIENT INGESTION | HAZARD QUOTIENT DERMAL | TOTAL HAZARD QUOTIENT |
|---|---|---|---|---|---|---|---|---|---|
| Aluminum | 27766.6667 | | | | | | | | |
| Antimony | 83 | 1.00 | 1.6E-06 | 0.10 | 7.5E-06 | 4.0E-04 | 4.1E-03 | 1.9E-02 | 2.3E-02 |
| Arsenic | 6.1833 | 1.00 | 1.2E-07 | 0.03 | 1.7E-07 | 3.0E-04 | 4.0E-04 | 5.6E-04 | 9.6E-04 |
| Barium | 11.8333 | 0.71 | 1.6E-07 | 0.05 | 5.8E-07 | 7.0E-02 | 2.3E-06 | 8.3E-06 | 1.1E-05 |
| Beryllium | 1.0438 | 1.00 | 2.0E-08 | 0.03 | 2.8E-08 | 5.0E-03 | 4.1E-06 | 5.7E-06 | 9.7E-06 |
| Cadmium | 0.8 | 1.00 | 1.6E-08 | 0.14 | 1.0E-07 | 5.0E-04 | 3.1E-05 | 2.0E-04 | 2.3E-04 |
| Calcium | 631.1111 | | | | | | | | |
| Chromium III | 2469.6 | 1.00 | 4.8E-05 | 0.04 | 8.9E-05 | 1.0E+00 | 4.8E-05 | 8.9E-05 | 1.4E-04 |
| Cobalt | 3.6111 | 1.86 | 1.3E-07 | 0.14 | 4.7E-07 | 6.0E-02 | 2.2E-06 | 7.8E-06 | 9.9E-06 |
| Copper | 34.8781 | | | | | | | | |
| Iron | 18305.5556 | | | | | | | | |
| Lead | 21.875 | 0.50 | 2.1E-07 | 0.01 | 1.2E-07 | 7.5E-04 | 2.9E-04 | 1.6E-04 | 4.4E-04 |
| Manganese | 52 | 1.86 | 1.9E-06 | 0.14 | 6.7E-06 | 4.7E-02 | 4.0E-05 | 1.4E-04 | 1.8E-04 |
| Mercury | 0.1814 | 1.00 | 3.5E-09 | 0.05 | 8.2E-09 | 3.0E-04 | 1.2E-05 | 2.7E-05 | 3.9E-05 |
| Nickel | 6.6861 | 1.00 | 1.3E-07 | 0.35 | 2.1E-06 | 2.0E-02 | 6.5E-06 | 1.1E-04 | 1.1E-04 |
| Potassium | 621.1111 | | | | | | | | |
| Sodium | 511.5556 | | | | | | | | |
| Vanadium | 13.9889 | 0.71 | 1.9E-07 | 0.05 | 6.9E-07 | 7.0E-03 | 2.8E-05 | 9.8E-05 | 1.3E-04 |
| Zinc | 20.3167 | 1.00 | 4.0E-07 | 0.02 | 3.7E-07 | 3.0E-01 | 1.3E-06 | 1.2E-06 | 2.5E-06 |
| Chloride | 376.5 | | | | | | | | |
| Nitrate as N | 2.875 | 0.71 | 4.0E-08 | 0.05 | 1.4E-07 | 1.6E+00 | 2.5E-08 | 8.8E-08 | 1.1E-07 |
| Nitrogen, Ammonia | 225.375 | 0.71 | 3.1E-06 | 0.05 | 1.1E-05 | 3.7E-01 | 8.5E-06 | 3.0E-05 | 3.8E-05 |
| Sulfate as SO4 | 1326.1111 | | | | | | | | |
| Chromium VI | 274.4 | 1.00 | 5.4E-06 | 0.09 | 2.2E-05 | 5.0E-03 | 1.1E-03 | 4.5E-03 | 5.5E-03 |
| | | | | | | SUMMARY HAZARD INDEX | 6E-03 | 3E-02 | 3E-02 |

[1] MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
ND = no data available

TRSDIDAL
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SEDIMENT - ALL DITCHES
RECEPTOR: NEIGHBORHOOD RESIDENT (AGES 7 THROUGH 16) - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A10-4

22-May-97

EXPOSURE PARAMETERS

| PARAMETER | SYMBOL | VALUE | UNITS | SOURCE |
|---|---|---|---|---|
| CONCENTRATION SEDIMENT | $[OHM]_{sediment}$ | chemical specific | chemical-specific | |
| INGESTION RATE | IR | 50 | mg-sediment/day | MADEP, 1995 |
| ADHERENCE FACTOR | AF | 0.51 | mg-sediment/cm^2-skin | MADEP, 1995 |
| AVERAGE SURFACE AREA (1) | SA | 4,521 | $cm^2$/day | calculated per MADEP, 1995 |
| RELATIVE ABSORPTION FACTOR-ORAL | RAF-O | chemical specific | unitless | MADEP, 1994, 1995 |
| RELATIVE ABSORPTION FACTOR -DERM | RAF-D | chemical specific | unitless | MADEP, 1994, 1995 |
| CONVERSION FACTOR | CF | 1.00E-06 | kg/mg | |
| BODY WEIGHT (2) | BW | 42 | kg | calculated per MADEP, 1995 |
| EXPOSURE PERIOD | EP | 10 | years | Assumption |
| EXPOSURE FREQUENCY (3) | EF | 6 | events/year | Assumption |
| EXPOSURE DURATION | ED | 1 | day/event | Assumption |
| AVERAGING PERIOD | | | | |
| CANCER | AP | 75 | years | MADEP, 1995 |
| NONCANCER | AP | 10 | years | Assumption |

(1) 50th percentile of surface areas for males aged 7 through 16 years: head, hands, forearms, lower legs.
(2) 50th percentile of body weights for males aged 7 through 16 years.
(3) 2 events per month, June through August.
MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
MADEP, 1995. Guidance for Disposal Site Risk Characterization. Interim Final Policy WSC/ORS-95-141. July 1995.

EQUATIONS

CANCER RISK = INTAKE (mg/kg-day) x CANCER SLOPE FACTOR (mg/kg-day)^-1

HAZARD QUOTIENT = INTAKE (mg/kg-day) / REFERENCE DOSE (mg/kg-day)

$$\text{INTAKE-INGESTION} = \frac{[OHM]sediment \times IR \times RAF\text{-}O \times CF \times EF \times ED \times EP}{BW \times AP \times 365\ days/yr}$$

$$\text{INTAKE-DERMAL} = \frac{[OHM]sediment \times SA \times AF \times RAF\text{-}D \times EF \times ED \times EP \times CF}{BW \times AP \times 365\ days/yr}$$

TRSDIDAL
EXPOSURE TO DIRECT CONTACT AND INCIDENTAL INGESTION OF SEDIMENT - ALL DITCHES
RECEPTOR: NEIGHBORHOOD RESIDENT (AGES 7 THROUGH 16) - FUTURE LAND USE
OLIN CORPORATION
WILMINGTON, MA FACILITY
TABLE A10-4

22-May-97

CARCINOGENIC EFFECTS

| COMPOUND | SEDIMENT CONCENTRATION (mg/kg) | INGESTION RAF [1] | INTAKE INGESTION (mg/kg-day) | DERMAL RAF [1] | INTAKE DERMAL (mg/kg-day) | CANCER SLOPE FACTOR (mg/kg-day)^-1 | CANCER RISK INGESTION | CANCER RISK DERMAL | TOTAL CANCER RISK |
|---|---|---|---|---|---|---|---|---|---|
| 1,1,2,2-Tetrachloroethane | 0.004 | 1.00 | 1.1E-11 | 1.40 | 7.4E-10 | 2.0E-01 | 2.3E-12 | 1.5E-10 | 1.5E-10 |
| 1,1-Dichloroethane | 0.017 | 0.99 | 4.5E-11 | 0.11 | 2.3E-10 | 5.7E-03 | 2.6E-13 | 1.3E-12 | 1.6E-12 |
| 1,2-Dichloropropane | 0.016 | 1.00 | 4.2E-11 | 0.20 | 3.9E-10 | 6.8E-02 | 2.9E-12 | 2.7E-11 | 3.0E-11 |
| Benzene | 0.013 | 1.00 | 3.5E-11 | 0.08 | 1.3E-10 | 2.9E-02 | 1.0E-12 | 3.7E-12 | 4.7E-12 |
| Bromodichloromethane | 0.005 | 1.00 | 1.3E-11 | 0.10 | 5.8E-11 | 6.2E-02 | 7.8E-13 | 3.6E-12 | 4.4E-12 |
| Bromoform | 0.020 | 1.00 | 5.1E-11 | 0.10 | 2.4E-10 | 7.9E-03 | 4.1E-13 | 1.9E-12 | 2.3E-12 |
| Carbon Tetrachloride | 0.008 | 1.00 | 2.1E-11 | 0.10 | 9.8E-11 | 1.3E-01 | 2.8E-12 | 1.3E-11 | 1.5E-11 |
| Chloroform | 0.007 | 1.00 | 1.7E-11 | 0.10 | 8.0E-11 | 6.1E-03 | 1.1E-13 | 4.9E-13 | 5.9E-13 |
| Dibromochloromethane | 0.017 | 1.00 | 4.3E-11 | 0.10 | 2.0E-10 | 8.4E-02 | 3.6E-12 | 1.7E-11 | 2.0E-11 |
| Methylene Chloride | 0.019 | 1.00 | 4.9E-11 | 0.10 | 2.3E-10 | 7.5E-03 | 3.7E-13 | 1.7E-12 | 2.1E-12 |
| Tetrachloroethene (PCE) | 0.016 | 1.00 | 4.2E-11 | 0.10 | 1.9E-10 | 5.1E-02 | 2.1E-12 | 9.9E-12 | 1.2E-11 |
| Trichloroethene (TCE) | 0.022 | 1.00 | 5.7E-11 | 0.10 | 2.6E-10 | 1.5E-02 | 8.5E-13 | 3.9E-12 | 4.8E-12 |
| Vinyl Chloride | 0.009 | 1.53 | 3.5E-11 | 0.16 | 1.7E-10 | 1.9E+00 | 6.7E-11 | 3.2E-10 | 3.9E-10 |
| Benzo(a)Anthracene | 1.679 | 1.00 | 4.4E-09 | 0.20 | 4.0E-08 | 7.3E-01 | 3.2E-09 | 3.0E-08 | 3.3E-08 |
| Benzo(a)Pyrene | 0.614 | 1.00 | 1.6E-09 | 0.20 | 1.5E-08 | 7.3E+00 | 1.2E-08 | 1.1E-07 | 1.2E-07 |
| Benzo(b)Fluoranthene | 1.119 | 1.00 | 2.9E-09 | 0.20 | 2.7E-08 | 7.3E-01 | 2.1E-09 | 2.0E-08 | 2.2E-08 |
| Benzo(k)Fluoranthene | 0.406 | 1.00 | 1.1E-09 | 0.20 | 9.8E-09 | 7.3E-02 | 7.7E-11 | 7.1E-10 | 7.9E-10 |
| Butylbenzylphthalate | 38.403 | | | | | ND | | | |
| Chrysene | 1.159 | 1.00 | 3.0E-09 | 0.20 | 2.8E-08 | 7.3E-03 | 2.2E-11 | 2.0E-10 | 2.3E-10 |
| Dibenzo(a,h)Anthracene | 0.161 | 1.00 | 4.2E-10 | 0.09 | 1.7E-09 | 7.3E+00 | 3.1E-09 | 1.3E-08 | 1.6E-08 |
| Indeno (1,2,3-cd)Pyrene | 9.755 | 1.00 | 2.5E-08 | 0.20 | 2.3E-07 | 7.3E-01 | 1.9E-08 | 1.7E-07 | 1.9E-07 |
| N-Nitrosodiphenylamine | 221.085 | 0.91 | 5.2E-07 | 0.17 | 4.5E-06 | 4.9E-03 | 2.6E-09 | 2.2E-08 | 2.5E-08 |
| bis(2-EthylHexyl)phthalate | 6154.127 | 1.00 | 1.6E-05 | 0.02 | 1.5E-05 | 1.4E-02 | 2.2E-07 | 2.1E-07 | 4.3E-07 |
| 4,4'-DDD | 0.048 | 1.00 | 1.3E-10 | 0.20 | 1.2E-09 | 2.4E-01 | 3.0E-11 | 2.8E-10 | 3.1E-10 |
| 4,4'-DDT | 0.068 | 1.00 | 1.8E-10 | 0.20 | 1.6E-09 | 3.4E-01 | 6.1E-11 | 5.6E-10 | 6.2E-10 |
| Aldrin | 0.032 | 1.00 | 8.5E-11 | 0.25 | 9.8E-10 | 1.7E+01 | 1.4E-09 | 1.7E-08 | 1.8E-08 |
| Alpha-BHC | 0.004 | 0.96 | 9.6E-12 | 0.18 | 8.3E-11 | 6.3E+00 | 6.1E-11 | 5.2E-10 | 5.8E-10 |
| Alpha-Chlordane | 0.198 | 1.00 | 5.2E-10 | 0.05 | 1.2E-09 | 1.3E+00 | 6.7E-10 | 1.5E-09 | 2.2E-09 |
| Beta-BHC | 0.033 | 0.96 | 8.3E-11 | 0.18 | 7.2E-10 | 1.8E+00 | 1.5E-10 | 1.3E-09 | 1.4E-09 |
| Gamma-Chlordane | 0.207 | 1.00 | 5.4E-10 | 0.05 | 1.2E-09 | 1.3E+00 | 7.0E-10 | 1.6E-09 | 2.3E-09 |
| Heptachlor | 0.031 | 1.00 | 8.1E-11 | 0.20 | 7.5E-10 | 4.5E+00 | 3.6E-10 | 3.4E-09 | 3.7E-09 |
| Heptachlor Epoxide | 0.028 | 1.00 | 7.4E-11 | 0.20 | 6.8E-10 | 9.1E+00 | 6.7E-10 | 6.2E-09 | 6.9E-09 |
| Arsenic | 34.447 | 1.00 | 9.0E-08 | 0.03 | 1.2E-07 | 1.5E+00 | 1.3E-07 | 1.9E-07 | 3.2E-07 |
| Beryllium | 0.804 | 1.00 | 2.1E-09 | 0.03 | 2.9E-09 | 4.3E+00 | 9.0E-09 | 1.2E-08 | 2.1E-08 |
| Cadmium | 1.174 | | | | | ND | | | |
| Lead | 46.258 | | | | | ND | | | |
| | | | | | SUMMARY CANCER RISK | | 4E-07 | 6E-07 | 1E-06 |

[1] MADEP, 1994. Background Documentation for the Development of MCP Numerical Standards. April 1994.
ND = no data available